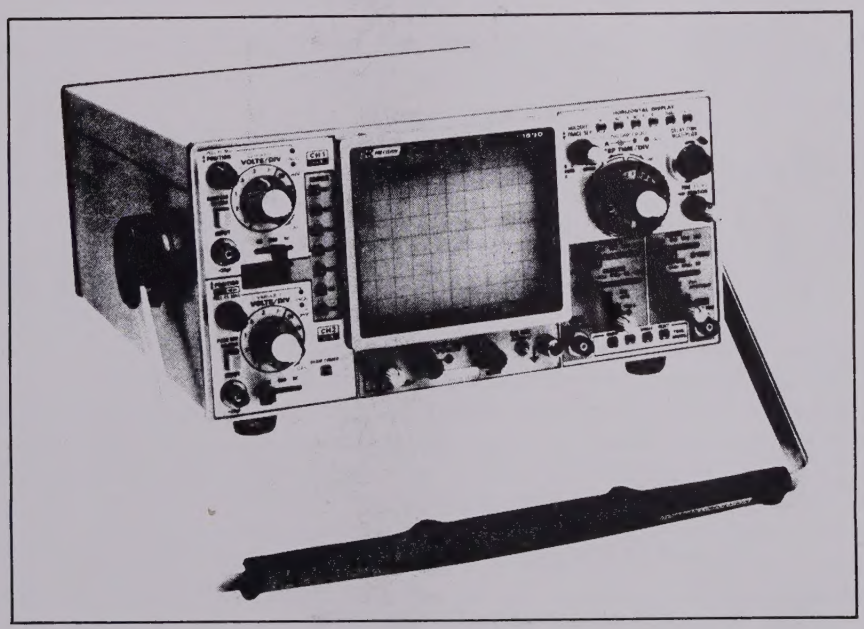
BK PRECISION®

SERVICE MANUAL

MODEL 1570 & 1590
QUAD TRACE OSCILLOSCOPES

VOLUME I



BK PRECISION®

TEST INSTRUMENT SAFETY

WARNING

Normal use of test equipment exposes you to a certain amount of danger from electrical shock because testing must often be performed where exposed high voltage is present. An electrical shock causing 10 milliamps of current to pass through the heart will stop most human heartbeats. Voltage as low as 35 volts dc or ac rms should be considered dangerous and hazardous since it can produce a lethal current under certain conditions. Higher voltages pose an even greater threat because such voltage can more easily produce a lethal current. Your normal work habits should include all accepted practices that will prevent contact with exposed high voltage, and that will steer current away from your heart in case of accidental contact with a high voltage. You will significantly reduce the risk factor if you know and observe the following safety precautions:

1. Don't expose high voltage needlessly. Remove housings and covers only when necessary. Turn off equipment while making test connections in high-voltage circuits. Discharge high-voltage capacitors after removing power.

2. If possible, familiarize yourself with the equipment being tested and the location of its high voltage points. However, remember that high voltage may appear at unexpected points in defective equipment.

3. Use an insulated floor material or a large, insulated floor mat to stand on, and an insulated work surface on which to place equipment; and make certain such surfaces are not damp or wet. Where insulated floor surace is not available, wear heavy gloves.

4. Use the time-proven "one hand in the pocket" technique while handling an instrument probe. Be particularly careful to avoid contacting a nearby metal object that could provide a good ground return path.

5. When using a probe, touch only the insulated portion. Never touch the exposed tip portion.

6. When testing ac powered equipment, remember that ac line voltage is usually present on some power input circuits such as on-off switch, fuses, power transformer, etc. any time the equipment is connected to an ac outlet, even if the equipment is turned off.

7. Some equipment with a two-wire ac power cord is transformerless "hot chassis" powered, where one side of the ac power line connects directly to the chassis. If such equipment does not have a polarized plug to prevent insertion the "wrong" way, a serious shock hazard exists if the chassis is touched. Not only does this present a dangerous shock hazard, but damage to test instruments or the equipment under test may result from connecting the ground lead of most test instruments (including this oscilloscope) to a "hot chassis". To make measurements in "hot chassis" equipment, always connect an isolation transformer between the ac outlet and the equipment under test. The **B & K-Precision** Model TR-110 Isolation Transformer is suitable for most applications. To be on the safe side, treat all two-wire ac powered equipment as "hot chassis" unless you are sure it has an isolated chassis or an earth ground chassis.

8. Never work alone. Someone should be nearby to render aid if necessary. Training in CPR (cardio-pulmonary resuscitation) first aid is highly recommended.

SERVICE MANUAL

for

B & K-PRECISION

Model 1570 & 1590

QUAD-TRACE OSCILLOSCOPES

WARNING

This service manual is intended for use by qualified electronics technicans only. To avoid electric shock, do not perform servicing unless you are qualified to do so.

High voltages up to 16,000 Vdc (Model 1590) or 12,000 Vdc (Model 1570) are present when this instrument is operating. Line voltage (120 or 240 Vac) is present on the power input circuit whenever the ac power cord is connected to a live outlet, even if the scope is turned off. Observe all high voltage safety precautions when the housing is removed from the oscilloscope. Contacting exposed high voltage could result in fatal electric shock.

6470 West Cortland Street
Chicago, Illinois 60635

use this address for technical inquiries and replacement parts orders

SERVICE MANUAL ADDENDUM

for

MODEL 1570/1590

QUAD-TRACE OSCILLOSCOPE

IMPROVED SPECIFICATIONS FOR MODEL 1570 - 80 MHz BANDWIDTH

The -3 dB frequency response specification for the Model 1570 Oscilloscope has been changed from "dc to 70 MHz" to "dc to 80 MHz". There is no circuit change. This change merely reflects the consistent performance of the Model 1570 well beyond its previous bandwidth specification of 70 MHz. Factory adjustment and testing procedures have been modified to assure that all units meet or exceed the new 80 MHz specification.

Change all -3 dB bandwidth references in the service manual from "70 MHz" to "80 MHz". The calibration adjustment procedure is unchanged, except that the minimum acceptable frequency response (Fig. 48) should be increased from 70 MHz to 80 MHz.

TABLE OF CONTENTS

VOLUME I
(Part No. 494-117-9-001)

Page

TEST INSTRUMENT SAFETY ..... inside front cover

DIFFERENCES BETWEEN MODELS 1
- Similarities 1
- Differences 1

SPECIFICATIONS 3

ACCESSORIES 11
- Accessories Supplied 11
- Optional Accessories 11
- Probe Holder 11
- LC-100 Front Panel Protective Cover 11
- LC-150 Probe Pouch 11
- PR-45 Probe 13
- PR-40 10:1/Direct Probe 15
- PR-37 Deluxe 10:1/Direct Probe 18
- Connecting Cables 21

CONTROLS AND INDICATORS 23
- Introduction 23
- Display and General Controls 24
- Vertical Controls 25
- Horizontal Controls 28
- Triggering Controls 30
- Other Controls 34
- Summary of Dual Sweep Operation 35

CIRCUIT DESCRIPTION 39
- General 39
- Vertical Attenuator Circuit Board 39
- Vertical Preamplifier Board 42
- Vertical Output Amplifier 43
- A Trigger Switch Circuit Board 45
- B Trigger Switch Circuit Board 46
- Sweep Rotary Switch Circuit Board 46
- Trigger & Sweep Circuit Board 46
- Horizontal Output Amplifier Board 51
- Horizontal Mode Control Circuit Board 51
- Switching Power Supply 53
- Power Supply & Blanking Circuit Board 53
- High Voltage Power Supply 54

DISASSEMBLY 57
General 57
Removal of Case 57
CRT Removal/Installation 58
Printed Circuit Board Removal 59

TROUBLESHOOTING 67

PARTS LIST 85
Parts Ordering Information 85
Mechanical Parts 86
Packing Drawing 98
Electrical Parts 100

CALIBRATION 129
General 129
Test Equipment Required 129
Preliminary Procedure 129
Power Supply and CRT Checks and Adjustments 133
Vertical Axis Adjustments 136
Sweep Adjustments 145
X-Y Adjustments 149
Final Trigger Adjustments 150
Delay Time Multiplier 151
Calibration Square Wave 152

VOLUME II
SCHEMATIC DIAGRAMS AND CIRCUIT BOARD MAPS
(Part No. 494-117-9-002)

Interconnect Diagram (Model 1590) 1
Interconnect Diagram (Model 1570) 3
Vertical Attenuator Assembly 4
Vertical Preamplifier Assembly (Model 1590) 6
Vertical Preamplifier Assembly (Model 1570) 9
Vertical Output Amplifier Assembly 10
Sweep Rotary Switch Assembly 12
A Trigger Switch Assembly 14
B Trigger Switch Assembly 16
Trigger & Sweep Assembly 18
Horizontal Output Amplifier Assembly 20
Horizontal Mode Control Assembly 22
Power Supply & Blanking Assembly 24

REFERENCE PUBLICATIONS

Model 1570 Operator's Manual 480-339-9-001
Model 1570 Schematic Diagrams and
Parts Lists 499-232-9-001
Model 1590 Operator's Manual 480-360-9-001
Model 1590 Schematic Diagrams and
Parts Lists 499-246-9-001

DIFFERENCES BETWEEN MODELS

SIMILARITIES

Because the Model 1570 and 1590 Quad-Trace Oscilloscopes have so many similarities in mechanical construction and circuit design, both models are covered in the same service manual. At least 80% of the servicing information is applicable to both models, and all differences between models are explicitly defined throughout this manual. *Unless otherwise noted, all information in this service manual is applicable to both Model 1570 and 1590.*

While the Model 1590 offers 100 MHz bandwidth and 3.5 ns rise time, the lower cost Model 1570 offers 70 MHz bandwidth and 5 ns rise time. Except for bandwidth and rise time, the Model 1570 offers essentially the same performance specifications as the Model 1590. However, several of the convenience features are omitted on the Model 1570.

DIFFERENCES

In most cases, the schematic diagrams for the Model 1570 are identical to those for the Model 1590 except for omission of certain circuits. In such cases, shaded areas of the schematic diagrams define those circuits which are omitted in Model 1570. In those cases where circuit differences may be confusing if combined onto a single diagram, separate schematic diagrams are provided. A summary of all functional differences between the Model 1570 and 1590 follows.

Dual Horizontal Display Mode

Only the Model 1590 offers the DUAL mode of horizontal display, wherein the A sweep and B sweep operate independently. This mode is omitted in Model 1570.

Maximum Sweep Speed

The A sweep has 23 steps and the B sweep has 20 steps on the Model 1590 with a maximum sweep speed of 20 ns/div (2 ns/div when using 10X magnification). Model 1570 has one less step on the A sweep and B sweep speed selectors respectively, with a maximum sweep speed of 50 ns/div (5 ns/div when using 10X magnification).

UNCAL and X5 GAIN Indicators

On Model 1590, LED indicators on the front panel remind the operator that the channel 1 vertical attenuator, channel 2 vertical attenuator, or A sweep time selections are not calibrated, or that the channel 1 or channel 2 vertical amplifiers are in the X5 GAIN mode. These indicators are omitted on Model 1570.

50 Ω Input

The channel 1 and channel 2 vertical inputs have selectable 50 Ω or 1 MΩ input impedances on Model 1590. On Model 1570, the input impedance is fixed at 1 MΩ.

CH 3 & CH 4 Input Attenuator

On Model 1590 Oscilloscopes, the channel 3 and channel 4 vertical inputs (which are also used as external A and B trigger inputs) have selectable unattenuated (1/1) or attenuated (1/10) input levels. In Model 1570, the 1/10 attenuators are omitted.

FIX Mode Triggering

Model 1590 offers selectable FIX mode triggering, wherein the triggering level is automatically fixed at the center of the triggering waveform. This feature is omitted in Model 1570.

B Trigger Coupling

For Model 1590, the B trigger coupling is selectable between AC, LF Rej, HF Rej, or DC. For Model 1570, AC coupling is always used.

Offset Chop Frequency

Model 1590 includes selectable normal or offset chop frequency. For Model 1570, the selectable offset chop frequency is omitted.

Current Probe Calibration

Model 1590 includes a calibrated current loop on the rear panel for adjustment of a current probe. This feature is omitted on Model 1570.

Gate A & B Outputs

Output jacks on the rear panel of Model 1590 provide gate pulses coincident with sweep A and sweep B. This feature is omitted on Model 1570.

Mode Memory

Model 1570 uses a storage capacitor to power the mode memory circuits, and will retain mode memory for at least two days. Model 1590 uses a Lithium battery, which will retain mode memory indefinitely.

Beam Finder

A BEAM FINDER pushbutton on Model 1590 shrinks and intensifies the beam for easy location of the beam when it is blanked or deflected off the viewing area of the CRT. This feature is omitted on Model 1570.

CRT Circuit

The CRT used in the Model 1570 and 1590 have different internal construction and a different pin arrangement. The CRT for the 1590 also uses an additional Y-axis (perpendicularity) adjustment coil. As a result, the CRT wiring scheme differs considerably between models; thus, a separate interconnect diagram is provided for each model. The Model 1570 also uses an acceleration voltage of 12 kV versus 16 kV for Model 1590 (different encapsulated high voltage power supply).

Vertical Pre-Amplifier

The basic circuit configuration of the vertical pre-amplifier is the same for both models, but several frequency compensation components are unique to each model. Thus, separate schematic diagrams are provided for each model.

SPECIFICATIONS

MODEL 1590

VERTICAL AMPLIFIERS (CH 1 and CH 2)

Sensitivity:

Standard:
5 mv/div to 5 V/div in 10 ranges, 1-2-5 sequence, each with vernier adjustment. LED UNCAL reminder.

X5 Gain:
1 mV/div to 1 V/div. LED X5 GAIN reminder.

Cascaded (CH 1 to CH 2):
500 µV/div.

Accuracy:
±3% (+10° to +35° C).
±5% (0° to +50° C).
±8% (cascaded operation, CH 1 to CH 2).

Frequency Response: (Specifications apply for X1 or X5 vertical gain)

DC:
DC to 100 MHz (-3 dB).
DC to 120 MHz (-6 dB).
DC to 70 MHz (cascaded).

AC:
5 Hz to 100 MHz (-3 dB).
5 Hz to 120 MHz (-6 dB).
7 Hz to 70 MHz (cascaded).

Rise Time:
3.5 ns or less at both 50 Ω and 1 MΩ input. Specification applies for X1 and X5 vertical gain.

Bandwidth Limiting:
Frequency response can be limited to approximately 20 MHz by bandwidth limit switch.

Input Impedance:
1 MΩ ±2% shunted by approx 28 pF; or 50 Ω ±2% (switch selectable).

CH 2 Polarity:
Normal or inverted.

MODEL 1570

VERTICAL AMPLIFIERS (CH 1 and CH 2)

Sensitivity:

Standard:
5 mv/div to 5 V/div in 10 ranges, 1-2-5 sequence, each with vernier adjustment.

X5 Gain:
1 mV/div to 1 V/div.

Cascaded (CH 1 to CH 2):
500 µV/div.

Accuracy:
±3% (+10° to +35° C).
±5% (0° to +50° C).
±8% (cascaded operation, CH 1 to CH 2).

Frequency Response: (Specifications apply for X1 or X5 vertical gain)

DC:
DC to 70 MHz (-3 dB).
DC to 80 MHz (-6 dB).
DC to 40 MHz (cascaded).

AC:
5 Hz to 70 MHz (-3 dB).
5 Hz to 80 MHz (-6 dB).
7 Hz to 40 MHz (cascaded).

Rise Time:
5 ns or less. Specification applies for X1 or X5 vertical gain.

Bandwidth Limiting:
Frequency response can be limited to approximately 20 MHz by bandwidth limit switch.

Input Impedance:
1 Megohm ±2% shunted by approx. 28 pF.

CH 2 Polarity:
Normal or inverted.

MODEL 1590

Maximum Input Voltage:
1 MΩ Mode:
250 V (dc + ac peak) or 500 V ac p-p.
50 Ω Mode:
5 V rms or dc.

Crosstalk:
-40 dB minimum.

VERTICAL AMPLIFIERS (CH 3 and CH 4)

Sensitivity:
1:1 . . . . . 0.1 V/div ±3%.
10:1 . . . . . 1 V/div ±3%.

Frequency Response:
DC to 100 MHz (-3 dB).
DC to 120 MHz (-6 dB).

Rise Time:
3.5 ns or less.

Input Impedance:
1 Megohm ±2% shunted by approx. 28 pF.

Input Coupling:
DC only.

Maximum Input Displayed:
1:1
DC Component . . . . . ±0.5 V.
AC Component . . . . . 1 V p-p.
10:1
DC Component . . . . . ±5 V.
AC Component . . . . . ±10 V p-p.

Maximum Input Voltage:
50 V (dc + ac peak).

VERTICAL AMPLIFIERS (CH 1 thru 4)

Operating Modes:
CH 1 . . . . . CH 1, single trace.
CH 2 . . . . . CH 2, single trace.
DUAL . . . . . CH 1 and CH 2, dual trace.
ADD . . . . . algebraic sum of CH 1 + CH 2, single trace (CH 1 - CH 2 with CH 2 inverted).
QUAD . . . . . CH 1 thru CH 4, four trace.

In DUAL and QUAD modes, alternating or chopped traces selectable with ALT and CHOP switches.

MODEL 1570

Maximum Input Voltage:
250 V (dc + ac peak) or 500 V ac p-p.

Crosstalk:
-40 dB minimum.

VERTICAL AMPLIFIERS (CH 3 and CH 4)

Sensitivity:
0.1 V/div ±3%.

Frequency Response:
DC to 70 MHz (-3 dB).
DC to 80 MHz (-6 dB).

Rise Time:
5 ns or less.

Input Impedance:
1 Megohm ±2% shunted by approx. 28 pF.

Input Coupling:
DC only.

Maximum Input Displayed:
DC Component . . . . . ±0.5 V.
AC Component . . . . . 1 V p-p.

Maximum Input Voltage:
50 V (dc + ac peak).

VERTICAL AMPLIFIERS (CH 1 thru 4)

Operating Modes:
CH 1 . . . . . CH 1, single trace.
CH 2 . . . . . CH 2, single trace.
DUAL . . . . . CH 1 and CH 2, dual trace.
ADD . . . . . algebraic sum of CH 1 + CH 2, single trace (CH 1 - CH 2 with CH 2 inverted).
QUAD . . . . . CH 1 thru CH 4, four trace.

In DUAL and QUAD modes, alternating or chopped traces selectable with ALT and CHOP switches.

MODEL 1590

Chop Frequency:
Approx. 250 kHz, switchable to slightly offset chop frequency.

Signal Delay Time:
Fixed, approx. 30 ns visible delay.

Maximum Undistorted Amplitude:
8 divisions (dc to 100 MHz).

HORIZONTAL AMPLIFIER
(Input through channel 2 input)

Sensitivity:
Same as vertical channel 2.

Accuracy:
Same as vertical channel 2.

Frequency Response:
DC:
DC to 5 MHz (-3 dB).
DC to 6 MHz (-6 dB).
AC:
5 Hz to 5 MHz (-3 dB).
5 Hz to 6 MHz (-6 dB).

Input Impedance:
Same as vertical channel 2.

Maximum Input:
Same as vertical channel 2.

X-Y Operation:
CH 2 becomes X axis, CH 1 is Y axis.

X-Y Phase Difference:
3^{o} or less at 100 kHz.

SWEEP SYSTEM

Modes:
A . . . . . A sweep.
ALT . . . . . A sweep (intensified for duration of B sweep) and B sweep alternating.
A-INT-B . . . . . Duration of B sweep is displayed as an intensified portion of the A sweep.
B DLY'D . . . . . Delayed B sweep.
DUAL . . . . . Dual sweep, A and B sweeps independent.
X-Y . . . . . X-Y display mode.

MODEL 1570

Chop Frequency:
Approx. 250 kHz.

Signal Delay Time:
Fixed, approx. 20 ns visible delay.

Maximum Undistorted Amplitude:
8 divisions (dc to 70 MHz).

HORIZONTAL AMPLIFIER
(Input through channel 2 input)

Sensitivity:
Same as vertical channel 2.

Accuracy:
Same as vertical channel 2.

Frequency Response:
DC:
DC to 5 MHz (-3 dB).
DC to 6 MHz (-6 dB).
AC:
5 Hz to 5 MHz (-3 dB).
5 Hz to 6 MHz (-6 dB).

Input Impedance:
Same as vertical channel 2.

Maximum Input:
Same as vertical channel 2.

X-Y Operation:
CH 2 becomes X axis, CH 1 is Y axis.

X-Y Phase Difference:
3^{o} or less at 100 kHz.

SWEEP SYSTEM

Modes:
A . . . . . A sweep.
ALT . . . . . A sweep (intensified for duration of B sweep) and B sweep alternating.
A-INT-B . . . . . Duration of B sweep is displayed as an intensified portion of the A sweep.
B DLY'D . . . . . Delayed B sweep.
X-Y . . . . . X-Y display mode.

MODEL 1590

A Sweep:
20 ns/div to 0.5 s/div in 1-2-5 sequence, 23 steps. Vernier control provides fully adjustable sweep time between steps. LED UNCAL reminder.

B Sweep:
20 ns/div to 50 ms/div in 1-2-5 sequence, 20 steps.

Accuracy:
±3% (+10° to +35° C).
±6% (0° to +50° C).

Sweep Magnification:
10X, ±5% (+10° to +35° C),
±7% (0° to + 50° C).

Linearity:
±3%; 10X, ±5%.

Holdoff:
Continuously adjustable for A sweep from NORM to more than 5 times normal.

Trace Separation:
B sweep can be positioned from 0 to 4 divisions below A sweep, continuously adjustable.

Delay Method:
Continuous delay or trigger delay.

Delay Time:
0.2 to 10 times A SWEEP TIME/DIV setting, continuously adjustable.

Time Difference Measurement Accuracy:
±2% (+10° to +35° C).
±4% (0° to +50° C).

Delay Jitter:
1/20,000 of full scale sweep time.

TRIGGERING

A Trigger:
Modes:
AUTO (free run), NORM, SINGLE/RESET, FIX (triggering level automatically set to center of waveform).
Source:
V. MODE, CH 1, CH 2, (EXT) CH 3, (EXT) CH 3 1/10.

MODEL 1570

A Sweep:
50 ns/div to 0.5 s/div in 1-2-5 sequence, 22 steps. Vernier control provides fully adjustable sweep time between steps.

B Sweep:
50 ns/div to 50 ms/div in 1-2-5 sequence, 19 steps.

Accuracy:
±3% (+10° to +35° C).
±6% (0° to +50° C).

Sweep Magnification:
10X, ±5% (+10° to +35° C),
±7% (0° to + 50° C).

Linearity:
±3%; 10X, ±5%.

Holdoff:
Continuously adjustable for A sweep from NORM to more than 5 times normal.

Trace Separation:
B sweep can be positioned from 0 to 4 divisions below A sweep, continuously adjustable.

Delay Method:
Continuous delay or trigger delay.

Delay Time:
0.2 to 10 times A SWEEP TIME/DIV setting, continuously adjustable.

Time Difference Measurement Accuracy:
±2% (+10° to +35° C).
±4% (0° to +50° C).

Delay Jitter:
1/20,000 of full scale sweep time.

TRIGGERING

A Trigger:
Modes:
AUTO (free run), NORM, SINGLE/RESET.

Source:
V. MODE, CH 1, CH 2, (EXT) CH 3.

MODEL 1590

Coupling:

AC ..... 20 Hz to 100 MHz.
LF Rej..... 30 kHz to 100 MHz.
HF Rej ..... 20 Hz to 30 kHz.
DC ..... DC to 100 MHz.
VIDEO ..... Trigger signal is routed through sync separator. Horizontal sync pulses selected at sweep times of 50 µs/div and faster (LINE). Vertical sync pulses selected at sweep times of 0.1 ms/div and slower (FRAME).

Level:

±90°; permits selection of triggering at any point on the positive and negative slope of the displayed waveform.

Slope:

+/-.

LED Indicator:

Sweep A TRIG'D.

B Trigger:

Modes:

Starts after delay.
Triggerable after delay.

Source:

CH 1, CH 2, (EXT) CH 4,
(EXT) CH 4 1/10.

Coupling:

AC ..... 20 Hz to 100 MHz.
LF Rej..... 30 kHz to 100 MHz.
HF Rej ..... 20 Hz to 30 kHz.
DC ..... DC to 100 MHz.

Level:

±90°; permits selection of triggering at any point on the positive and negative slope of the displayed waveform.

Slope:

+/-.

LED Indicator:

Sweep B TRIG'D.

Trigger Jitter:

0.5 ns maximum at 100 MHz at 2 ns/div sweep rate (X10 MAG on).

MODEL 1570

Coupling:

AC ..... 20 Hz to 70 MHz.
LF Rej..... 30 kHz to 70 MHz.
HF Rej ..... 20 Hz to 30 kHz.
DC ..... DC to 70 MHz.
VIDEO ..... Trigger signal is routed through sync separator. Horizontal sync pulses selected at sweep times of 50 µs/div and faster (LINE). Vertical sync pulses selected at sweep times of 0.1 ms/div and slower (FRAME).

Level:

±90°; permits selection of triggering at any point on the positive and negative slope of the displayed waveform.

Slope:

+/-.

LED Indicator:

Sweep A TRIG'D.

B Trigger:

Modes:

Starts after delay.
Triggerable after delay.

Source:

CH 1, CH 2, (EXT) CH 4.

Coupling:

AC only ..... 20 Hz to 70 MHz.

Level:

±90°; permits selection of triggering at any point on the positive and negative slope of the displayed waveform.

Slope:

+/-.

LED Indicator:

Sweep B TRIG'D.

Trigger Jitter:

1 ns maximum at 70 MHz at 5 ns/div sweep rate (X10 MAG on).

MODEL 1590

Trigger Sensitivity (A and B):

COUPLING	BANDWIDTH	INT	EXT
DC	DC - 20MHz	0.5 div	50 mV
	DC - 50MHz	1.0 div	100 mV
	DC - 100MHz	1.5 div	150 mV
AC	Same as DC except lower limit is 20 Hz.		
HFREJ	Same as AC except increased attenuation above 30 kHz.		
LFREJ	Same as AC except increased attenuation below 30 kHz.		
VIDEO	FRAME	0.5 div	50 mV
	LINE	0.5 div	50 mV
AUTO	Same as AC except lower limit is 30 Hz.		
FIX	40Hz - 20MHz	1 div	100 mV
	40Hz - 80MHz	1.5 div	150 mV

OTHER SPECIFICATIONS

CRT:

Type:
150ATM31A, rectangular with internal graticule. P31 phosphor.

Display Area:
8 x 10 division (1 div = 1 cm).

Accelerating Voltage:
16 kV.

Calibration Output:

Positive Square Wave:
1 kHz ±3%.

Voltage:
0.3 V p-p ±1% (+10° to +35° C).
0.3 V p-p ±2% (0° to +50° C).

Current:
10 mA p-p ±2% (+10° to +35° C).
10 mA p-p ±4% (0° to +50° C).

Intensity Modulation:

Input Signal:
TTL level, intensity increasing with more positive levels.

Input Impedance:
Approx. 10 kΩ.

Usable Frequency Range:
DC to 10 MHz.

Maximum Input Voltage:
50 V (dc + ac peak).

MODEL 1570

Trigger Sensitivity (A and B):

COUPLING	BANDWIDTH	INT	EXT
DC	DC - 20 MHz	0.5 div	50 mV
	DC - 70 MHz	1.5 div	150 mV
AC	Same as DC except lower limit is 20 Hz.		
HFREJ	Same as AC except increased attenuation above 30 kHz.		
LFREJ	Same as AC except increased attenuation below 30 kHz.		
VIDEO	FRAME	0.5 div	50 mV
	LINE	0.5 div	50 mV
AUTO	Same as AC except lower limit is 30 Hz.		

OTHER SPECIFICATIONS

CRT:

Type:
150CTM31, rectangular with internal graticule. P31 phosphor.

Display Area:
8 x 10 division (1 div = 1 cm).

Accelerating Voltage:
12 kV.

Calibration Output:

Positive Square Wave:
1 kHz ±3%.

Voltage:
0.3 V p-p ±1% (+10° to +35° C).
0.3 V p-p ±2% (0° to +50° C).

Intensity Modulation:

Input Signal:
TTL level, intensity increasing with more positive levels.

Input Impedance:
Approx. 10 kΩ.

Usable Frequency Range:
DC to 10 MHz.

Maximum Input Voltage:
50 V (dc + ac peak).

MODEL 1590

CH 1 Output (on rear panel):
Output Voltage:
50 mV/div (into 50-ohm load).
Frequency Response:
DC to 100 MHz (-3 dB),
into 50-ohm load.
Output Impedance:
Approx. 50 ohms.

Gate Outputs (on rear panel):
Positive gate (pulse) output coincident with A sweep and B sweep respectively, 1.5 V p-p into 500 ohms.

Environment:
Operating:
+10° to +35° C, 85% maximum relative humidity for full specifications.
0° to +50° C, 90% maximum relative humidity, full operating range.
Storage:
-20° to +55° C, 80% maximum relative humidity.
Altitude:
Operating: up to 5000 meters (16,000 ft).
Non-operating: up to 12,000 meters (39,000 ft).

Trace Rotation:
Electrical, externally adjustable.

Mode Selection:
By "soft-touch" pushbuttons, LED indicator in face of each pushbutton shows which modes are selected.

Mode Memory:
Mode selection retained in memory when power is removed; returns to same modes when power is reapplied. Powered from Lithium battery, battery life at least 2 years.

Beam Finder:
Pushbutton shrinks and intensifies display.

Power Requirements:
90-132 VAC; 180-264 VAC 50/60 Hz, approx. 56 watts.

Dimensions:
13.8 x 28.4 x 40 cm (5 x 11-1/4 x 15-3/4").

Weight:
7.4 kg (16-1/4 lbs.)

MODEL 1570

CH 1 Output (on rear panel);
Output Voltage:
50 mV/div (into 50-ohm load).
Frequency Response:
DC to 70 MHz (-3 dB),
into 50-ohm load.
Output Impedance:
Approx. 50 ohms.

Environment:
Operating:
+10° to +35° C, 85% maximum relative humidity for full specifications.
0° to +50° C, 90% maximum relative humidity, full operating range.
Storage:
-20° to +55° C, 80% maximum relative humidity.
Altitude:
Operating: up to 5000 meters (16,000 ft).
Non-operating: up to 12,000 meters (39,000 ft).

Trace Rotation:
Electrical, externally adjustable.

Mode Selection:
By "soft-touch" pushbuttons, LED indicator in face of each pushbutton shows which modes are selected.

Mode Memory:
Mode selection retained in memory when power is removed; returns to same modes when power is reapplied. Powered from storage capacitor; charge typically retained at least two days.

Power Requirements:
90-132 VAC; 180-264 VAC 50/60 Hz, approx. 56 watts.

Dimensions:
13.8 x 28.4 x 40 cm (5 x 11-1/4 x 15-3/4").

Weight:
7.4 kg (16-1/4 lbs.)

ACCESSORIES

ACCESSORIES SUPPLIED

Two 10:1 Probes.
Probe Holder.
AC Power Cord.
Instruction Manual.
Composite (Schematic Diagrams & Parts List).

OPTIONAL ACCESSORIES

LC-100 Front Panel Protective Cover.
LC-150 Probe Pouch.
PR-40 10:1/Direct Probes.
PR-37 Deluxe 10:1/Direct Probes.
Connecting Cables.

PROBE HOLDER

The probe holder is attached to the combination handle and tilt stand as shown in Fig. 1. Install the probe holder as follows:

1. Rest the upper two claws of the probe holder on the top surface of the handle (see Fig. 1 inset).
2. Push lower claws toward handle to lock probe holder in place.
3. Probe can now be inserted into holder.

CAUTION

When disengaging the probe holder from handle, disengage lower jaw first to prevent breakage.

LC-100 FRONT PANEL PROTECTIVE COVER
(Dynascan Part No. 534-198-0-000)

This molded plastic cover snaps over the front panel for complete protection of the CRT and knobs when carrying and transporting the oscilloscope (see illustration in Fig. 59).

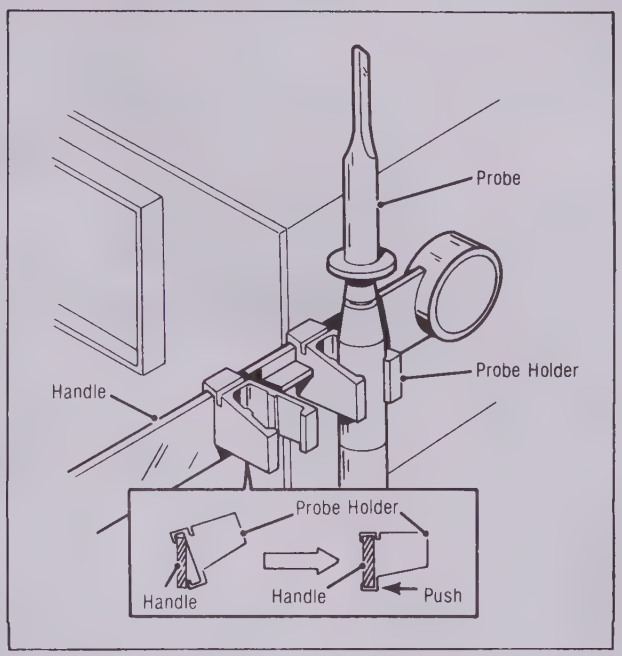


Fig. 1. Probe Holder Installation.

MODEL LC-150 PROBE POUCH
(Dynascan Part No. 534-199-0-000)

This soft vinyl pouch attaches to the right side of the oscilloscope housing and provides storage space for two probes and the instruction manual. Install the probe pouch as follows:

1. Unsnap the probe pouch from the retainer plate.
2. Place retainer plate with flap downward at right side of oscilloscope. Align plate so that the four corner holes the plate are lined up with the four holes in the case.
3. Attach the four corners of the retainer plate to the oscilloscope case with the four nylon rivets supplied.
4. Attach the probe pouch to the retainer plate using the five snap fasteners.

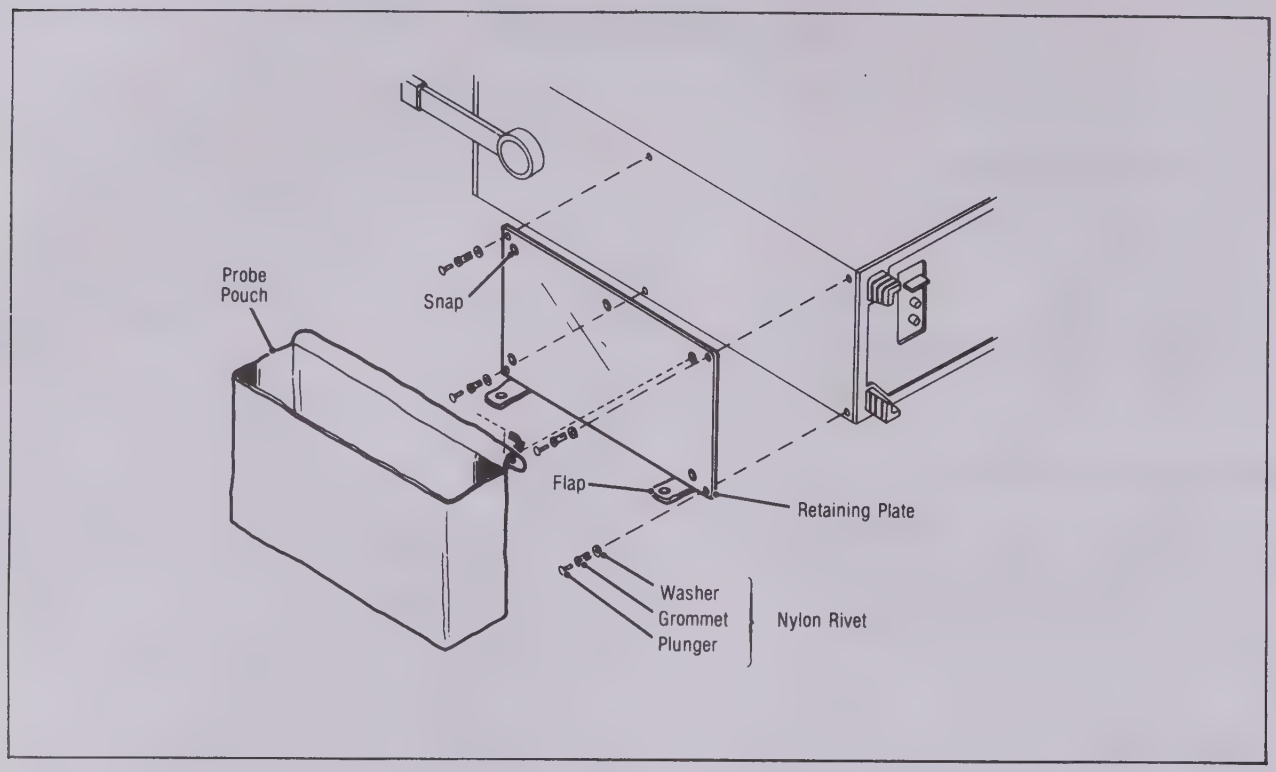


Fig. 2. LC-150 Probe Pouch Installation.

PR-45 PROBE

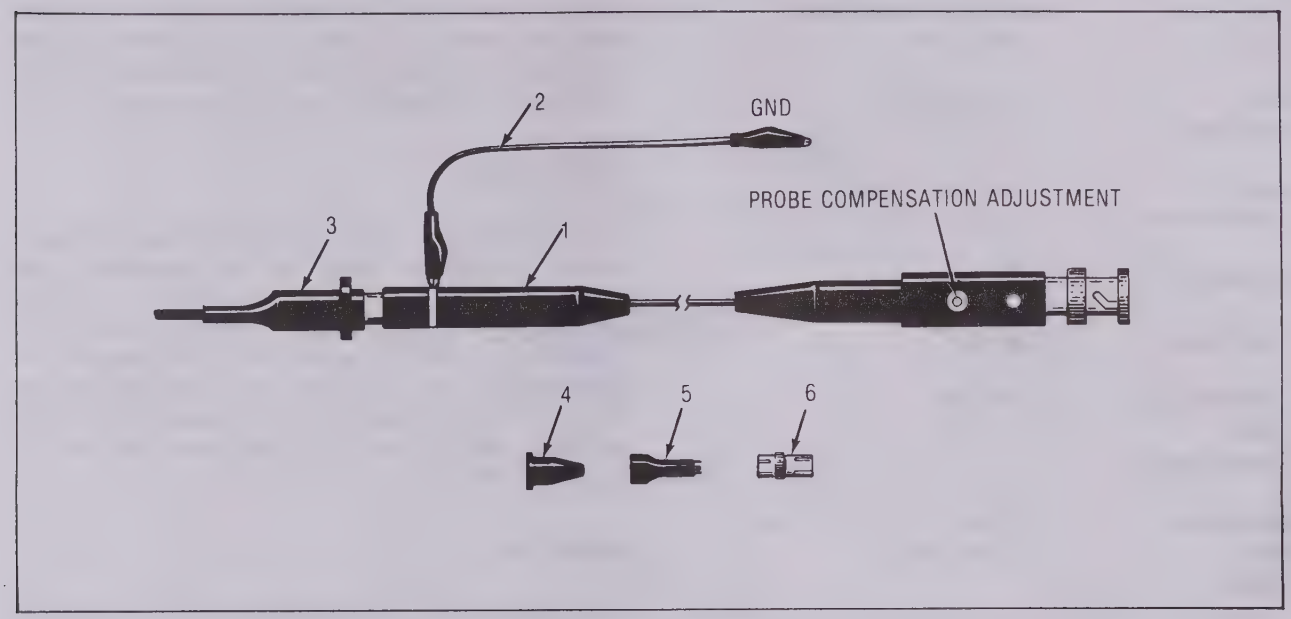


Fig. 3. PR-45 Probe.

ITEM	DESCRIPTION	PART NO.
	Complete PR-45 Probe with accessory tips	534-045-9-001
1	Probe & Cable Assembly	523-367-9-001
2	Ground Wire Assembly	523-369-9-001
3	Spring Hook Assembly	523-368-9-001
4	Insulating Tip	380-378-9-002
5	IC Tip	380-378-9-001
6	BNC Adapter	768-016-9-001
	Insulated Screwdriver	745-002-9-001
	Red Adhesive Strip	485-018-9-001
	Gray Adhesive Strip	485-018-9-002

SPECIFICATIONS

Attenuation	10:1 ±1% (at oscilloscope input impedance of 1 MΩ ±1%).
Input Impedance	10 MΩ ±1%.
Input Capacitance	Less than 18 pF.
Bandwidth	100 MHz.
Rise Time	3.5 ns.
Oscilloscope Input Capacitance	20-40 pF.
Maximum Input Voltage	500 volts p-p or 250 volts dc + ac peak.

DESCRIPTION

The B & K-Precision Model PR-45 Probe is designed for use with wideband oscilloscopes up to 100 MHz, and an input impedance of 1 megohms. Nominal input resistance of the probe is 10 megohms shunted by 18 pF, and bandwidth is 100 MHz. Signal attenuation is 10:1 when using the standard 1 megohm input impedance. If the oscilloscope has a selectable 50-ohm input impedance, use coaxial cable rather than this probe when the 50-ohm input is selected. This high impedance probe will cause very little error in measurements in circuits of 1 megohm impedance or less.

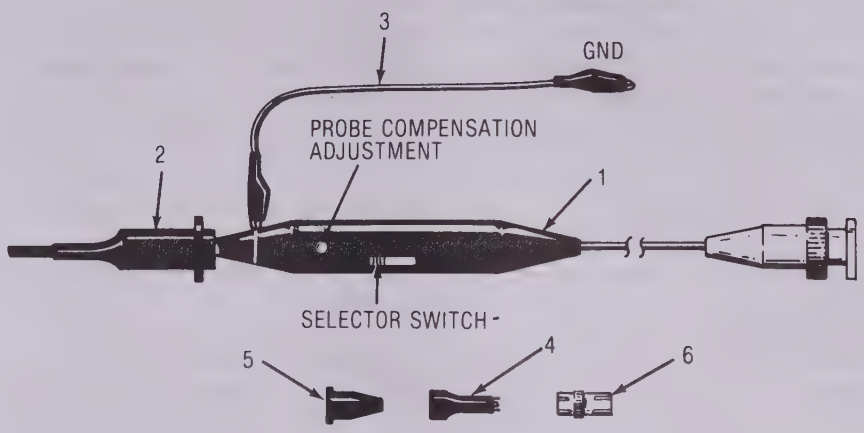
ADJUSTMENT

To adjust probe compensation connect probe to vertical input of oscilloscope. Use the oscilloscope's most sensitive vertical attenuator setting and, while observing a 1 kHz or 10 kHz square wave signal, adjust the trimmer on the probe with an insulated screwdriver for best square wave presentation; that is, least overshoot, tilt, and rounding off of square wave.

SERVICING

The probe is not repairable. This includes both repairs to the main probe assembly and replacement of the special type coaxial cable. The impedance, capacitance, and bandwidth characteristics of the probe are very critical, and can only be assured by assembly at the factory. Servicing consists of probe compensation adjustment and replacement of those items listed in the parts list.

PR-40 10:1/DIRECT PROBE



PR-40 10:1/Direct Probe.

ITEM	DESCRIPTION	PART NO.
	Complete PR-40 Probe with accessory tips	535-040-0-000
1	Probe & Cable Assembly	523-324-9-001
2	Spring Hook Assembly	523-316-9-001
3	Ground Wire Assembly	523-325-9-001
4	IC Tip	380-378-9-001
5	Insulating Tip	380-378-9-002
6	BNC Adapter	768-016-9-001
	Red Adhesive Strip	485-018-9-001
	Gray Adhesive Strip	485-018-9-002

SPECIFICATIONS

	10X position	1X position
Attenuation	10:1 ±1% (at oscilloscope input impedance of 1 MΩ ±1%)	
Input Impedance	10 MΩ ±1%	1 MΩ ±1%
Input Capacitance	less than 18 pF	less than 100 pF
Bandwidth	100 MHz	15 MHz
Rise Time	3.5 ns	24 ns
Compensation Range	15 to 40 pF	
Maximum Input Voltage	500 V p-p; 250 V dc + ac peak	

DESCRIPTION

The B & K-Precision Model PR-40 deluxe probe is designed for use with wideband oscilloscopes to 100 MHz. The PR-40 is a slim-body probe of precision lightweight construction. A three position switch selects 10:1 or direct modes, or a reference position that grounds the tip through a 9 megohm resistor.

Accessories included with the PR-40 are a spring-loaded retractable tip cover, insulating tip, BNC tip adapter, and IC tip. The insulating tip is designed for probing dense solid-state circuitry with little danger of shorting nearby components. The BNC adapter tip converts the probe tip into a push-on BNC fitting, ideal for interface with test points or output jacks. The IC tip guides the probe contact into any pin of a standard DIP, making it almost impossible to short two pins of an IC.

The PR-40 is supplied with both grey and red adhesive strips, which are particularly useful with a dual-trace scope for instant identification of the channel to which a probe is connected. The PR-40 and accessories come in a convenient vinyl case.

OPERATION

By setting the selector switch of the probe to the "1X" position, an unattenuated waveform can be observed. Note that bandwidth is 15 MHz in this position.

By setting the switch to the "10X" position, the probe input impedance is increased to 10 megohms and the waveform being observed is attenuated 10:1. The "10X" position must be used above 15 MHz and whenever the loading effect of the probe may disturb normal operation of a circuit. Signal attenuation is 10:1 when using the standard 1 megohm input impedance (use coaxial cable rather than the probe when terminated into 50 ohms). This high impedance probe will cause very little error in measurements in circuits of 1 megohm impedance or less.

The "REF" positon of the probe selector switch opens the probe input and grounds the oscilloscope input, allowing convenient measurement of reference level.

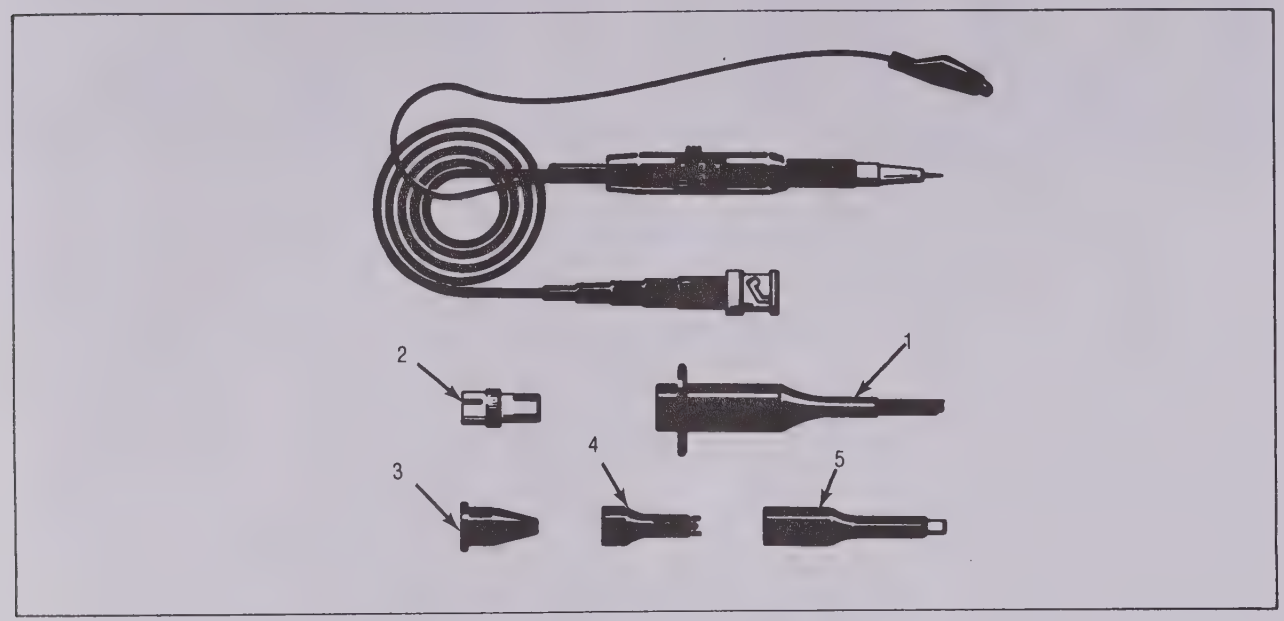
ADJUSTMENT

Set the probe selector switch to the "10X" position. Connect probe to vertical input of oscilloscope. Use the oscilloscope's most sensitive vertical attenuator setting and, while observing a 1 kHz or 10 kHz square wave signal, adjust the trimmer on the probe with an insulated screwdriver for best square wave presentation; that is, least overshoot, tilt, and rounding off of square wave.

SERVICING

The probe is not repairable. This includes both repairs to the main probe assembly and replacement of the special type coaxial cable. The impedance, capacitance, and bandwidth characteristics of the probe are very critical, and can only be assured by assembly at the factory. Servicing consists of probe compensation adjustment and replacement of those items listed in the parts list.

PR-37 DELUXE 10:1/DIRECT PROBE



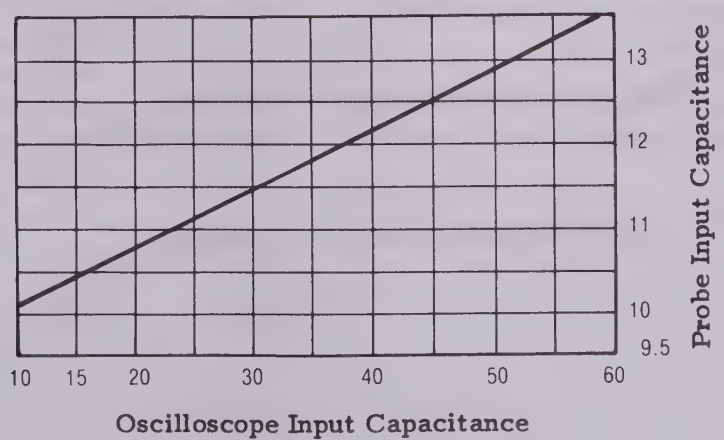
PR-37 Deluxe 10:1/Direct Probe.

ITEM	DESCRIPTION	PART NO.
	Complete Dual PR-37 Probe Set with accesory tips, 1 Gray and 1 Red	534-096-0-000
	Complete PR-37(G) Probe with accessory tips, Gray	534-097-0-000
	Complete PR-37(R) Probe with accessory tips, Red	534-098-0-000
1	Spring Hook Assembly, Gray	521-090-9-001
1	Spring Hook Assembly, Red	521-091-9-001
2	BNC Adapter	521-089-9-004
3	Insulating Tip	521-089-9-001
4	IC Tip	521-089-9-005
5	Trimmer Tool	521-089-9-003

SPECIFICATIONS

	10X position	1X position
Bandwidth	dc to 100 MHz	dc to 10 MHz
Rise Time	3.5 ns	35 ns
Input Impedance	10 MΩ ±1% (when used with oscilloscopes with a 1 MΩ input)	1 MΩ (oscilloscope input)
Input Capacitance	11.5 pF (when used with oscilloscopes which have 30 pF input capacitance) *	40 pF (plus oscilloscope capacitance)
Compensation Range	10 to 60 pF	
Maximum Input Voltage	600 volts p-p or dc + ac peak	
REF Positon	probe grounded via 9 MΩ resistor, oscilloscope input grounded	
Connector	BNC	
Length	approx. 60"	

* = for other values see graph.



DESCRIPTION

The B&K-PRECISION Model PR-37 deluxe probe is designed for use with wideband oscilloscopes to 100 MHz. The PR-37 is a slim-body probe of precision lightweight construction. A three position switch selects 10:1 or direct modes, or a reference position that grounds the tip through a 9-megohm resistor. The 52" coaxial cable is extremely flexible.

Accessories included with the PR-37 are a spring-loaded retractable tip cover, insulating tip BNC tip adapter, IC tip and an insulated compensation capacitor adjustment tool. The insulating tip is designed for probing dense solid-state circuitry with little danger of shorting nearby components. The BNC adapter tip converts the probe tip into a push-on BNC fitting, ideal for interface with test points or output jacks. The IC tip guides the probe contact into any pin of a standard DIP, making it almost impossible to short two pins of an IC.

The PR-37 is available in both grey and red colors. Probes of different colors are particularly useful with a dual-trace scope for instant identification of the channel to which a probe is connected. The PR-37 and accessories come in convenient zippered vinyl case. Model PR-37G is grey and PR-37R is red.

OPERATION

By setting the selector switch of the probe to the "1X" position, an unattenuated waveform can be observed. Note that bandwidth is 10 MHz in this position.

By setting the switch to the "10X" position, the probe input impedance is increased to 10 megohms and the waveform being observed is attenuated 10:1. The "10X" position must be used above 10 MHz and whenever the loading effect of the probe may disturb normal operation of a circuit. Signal attenuation is 10:1 when using the standard 1 megohm input impedance (use coaxial cable rather than the probe when terminated into 50 ohms). This high impedance probe will cause very little error in measurements in circuits of 1 megohm impedance or less.

The "REF" positon of the probe selector switch opens the probe input and grounds the oscilloscope input, allowing convenient display of reference level.

ADJUSTMENT

Set the probe selector switch to the "10X" position. Connect probe to vertical input of oscilloscope. Use the oscilloscope's most sensitive vertical attenuator setting and, while observing a 1 kHz or 10 kHz square wave signal, adjust the trimmer on the probe with an insulated screwdriver for best square wave presentation; that is, least overshoot, tilt, and rounding off of square wave.

SERVICING

The probe is not repairable. This includes both repairs to the main probe assembly and replacement of the special type coaxial cable. The impedance, capacitance, and bandwidth characteristics of the probe are very critical, and can only be assured by assembly at the factory. Servicing consists of probe compensation adjustment and replacement of those items listed in the parts list.

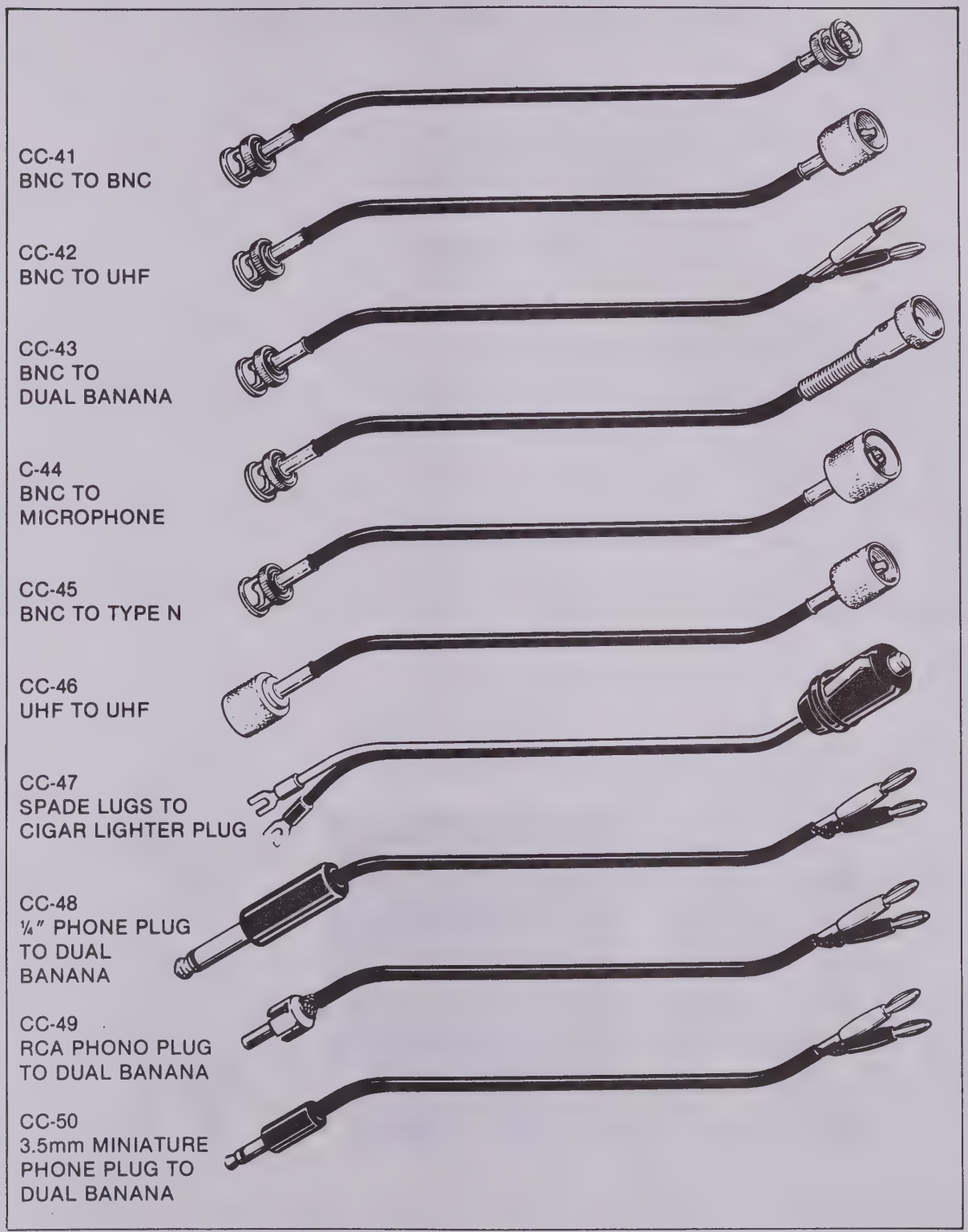


Fig. 4. Interconnect Cables.

CONTROLS AND INDICATORS

Unless otherwise stated, all information in this section applies equally to Model 1570 and 1590.
Shaded areas highlight differences between models.

INTRODUCTION

FUNCTIONAL GROUPING

Fig. 5 shows how the operator's controls are functionally grouped for convenience and ease of operation. Although these oscilloscopes are extremely versatile, sophisticated instruments with over 75 operator controls, the layout and identification of the controls simplify operation. All functionally related controls are grouped in clusters and identified to eliminate most operator errors. For example, all the general controls such as on/off, intensity, and focus are located in the center panel below the CRT. All vertical controls are located on the left side of the CRT. Within this grouping of vertical controls are subgroups of controls that are separately clustered and identified for vertical mode selection, control of channel 1 and control of channel 2. Likewise, all horizontal controls are located on the right side of the CRT. Within this grouping of horizontal controls are subgroups of controls that are separately clustered and identified for horizontal mode selection, sweep control, trigger mode selection, control of A sweep triggering, and control of B sweep triggering.

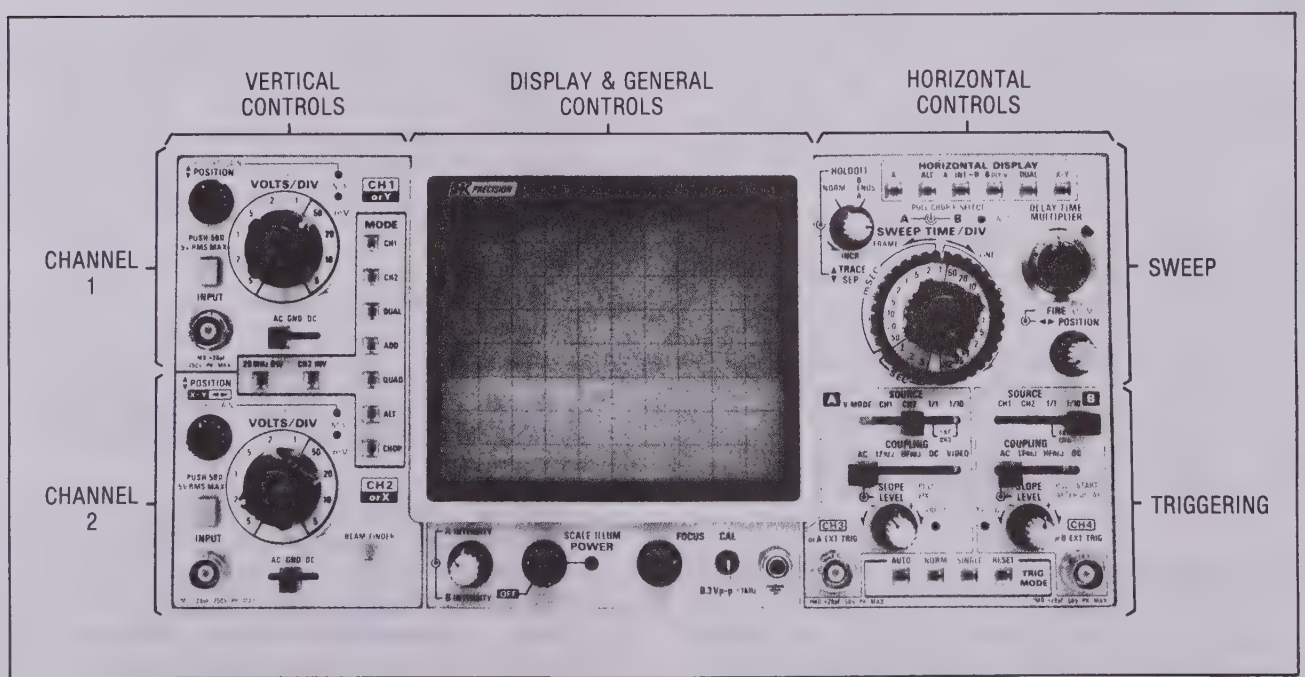


Fig. 5. Functional Grouping of Controls.

ELECTRONIC MODE SELECTION

Soft-touch pushbuttons select the desired modes of operation. However, the actual switching is accomplished by logic switching circuits. The logic circuits sense the combination of vertical, horizontal, and triggering modes selected and make all necessary circuit interconnections. This includes electronic interlocking when applicable so that selection of a new mode automatically cancels the previous selection. Additionally, the logic circuits indicate the presently selected modes by illuminating the face of those pushbuttons.

MODE SELECTION MEMORY

The Model 1570 and 1590 oscilloscopes incorporate mode selection memory; that is, once the operating modes are selected, they are retained in memory, even when the instrument is turned off. This is a major convenience, allowing you to restart operation in the same modes as when the scope was turned off.

Because the mode selection logic circuits are characterized by extremely low power consumption, mode selection memory became feasible by powering the circuits when the oscilloscope is turned off. Model 1590 uses a Lithium battery for powering the mode selection circuits, and battery life is at least two years. Model 1570 uses a 1000 µF storage capacitor, which will typically power the mode selection circuits at least two days (overnight or over the weekend).

DISPLAY AND GENERAL CONTROLS
(refer to Fig. 6)

1. **Cathode Ray Tube (CRT).** This is the screen on which the waveforms are viewed. This scope uses a rectangular CRT with an 8 x 10 division graticule scale. The graticule scale also contains 0%, 10%, 90% and 100% marks for convenience in making rise time measurements. Illumination of the graticule scale is fully adjustable.

2. ⏚ **Terminal/Binding Post.** Oscilloscope chassis ground, and earth ground via 3-wire ac power cord.

3. **CAL 0.3 V p-p = 1 kHz Terminal.** Provides 1 kHz, 0.3-volt peak-to-peak square wave signal. This is useful for probe compensation adjustment and a general check of oscilloscope calibration accuracy.

4. **FOCUS Control.** An auto-focus circuit automatically readjusts focus as intensity is varied. Once adjusted, this control does not require frequent readjustment.

5. **POWER Indicator.** LED lights when oscilloscope is turned on.

6. **SCALE ILLUM/POWER Control.** Fully counterclockwise rotation of this control (**OFF** position) turns off oscilloscope. Clockwise rotation turns on oscilloscope. Further clockwise rotation of the control increases the illumination of the graticule scale.

7. **A INTENSITY Control.** Adjusts brightness of trace generated by A sweep.

8. **B INTENSITY Control.** Adjusts brightness of trace generated by B sweep.

9. **BEAM FINDER Switch.** (Model 1590 only) Intensifies electron beam and shrinks display. Aids in locating beam when deflected beyond viewing area of screen, etc. Momentary action pushbutton is activated only when button is held in.

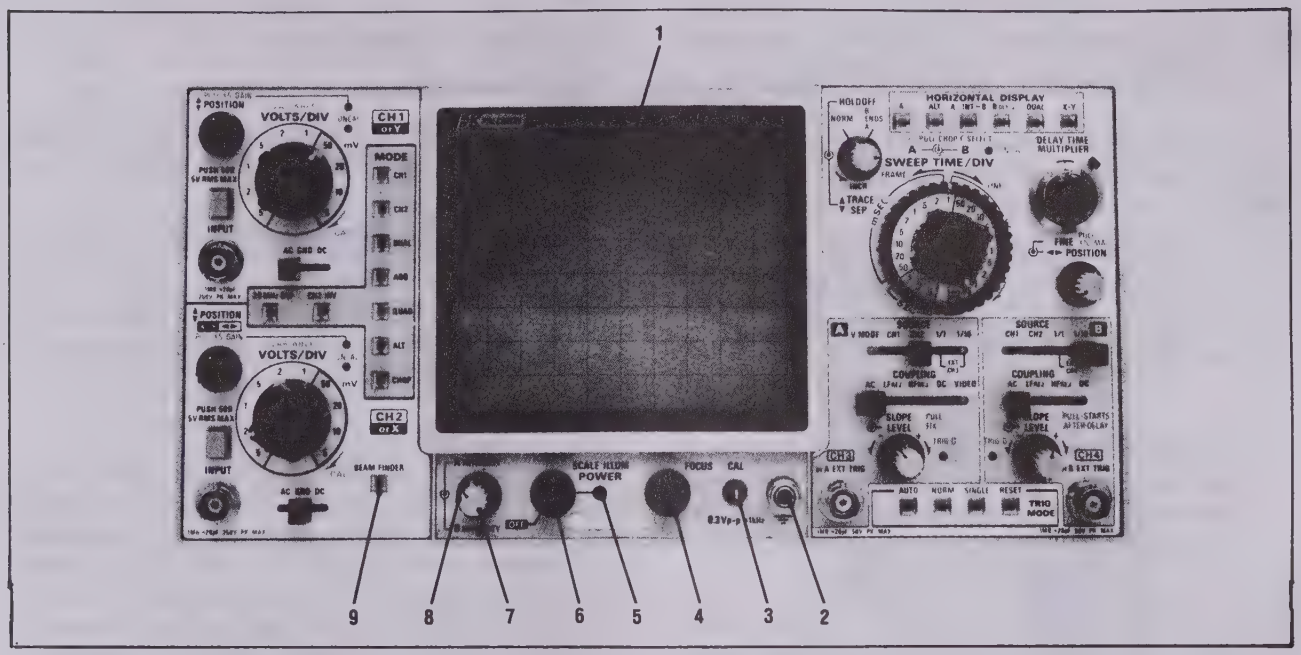


Fig. 6. Display and General Controls.

VERTICAL CONTROLS

VERTICAL MODE SELECTION
(refer to Fig. 7)

NOTE

The vertical mode settings are also related to horizontal mode and trigger source selection. Refer to **HORIZONTAL DISPLAY** and **SOURCE** controls for a description of this relationship.

The vertical **MODE** switch assembly contains nine soft-touch pushbuttons. Each pushbutton is internally illuminated to show which mode is presently selected.

The **CH 1, CH 2, DUAL, ADD,** and **QUAD** buttons are electonically interlocked; i.e., selection of a new mode automatically releases the previous selection.

10. **CH 1 Pushbutton.** Only the input signal to channel 1 is displayed on the CRT.

11. **CH 2 Pushbutton.** Only the input signal to channel 2 is displayed on the CRT.

12. **DUAL Pushbutton.** The input signal to channel 1 and channel 2 are displayed simultaneously on two traces.

13. **ADD Pushbutton.** The input from channel 1 and channel 2 are summed and displayed as a single signal. When the **CH 2 INV** function is activated, the input from channel 2 is subtracted from channel 1 and the difference is displayed as a single signal.

14. **QUAD Pushbutton.** The inputs to channels 1, 2, 3, and 4 are displayed simultaneously on four traces.

The **ALT** and **CHOP** buttons are electonically interlocked; i.e., selection of **CHOP** cancels **ALT,** and vice versa. The **ALT** and **CHOP** functions are enabled only in the **DUAL** and **QUAD** modes.

15. **ALT Pushbutton.** Selects alternate method of dual- or quad-trace display.

16. **CHOP Pushbutton.** Selects chop method of dual- or quad-trace display.

> The **20 MHz BW** and **CH 2 INV** buttons are independently latching; i.e., press once to activate function, press again to turn off function.

17. **CH 2 INV Pushbutton.** Selects inverted or normal polarity of channel 2 signal; inverted polarity when activated, normal polarity when off.

18. **20 MHz BW Pushbutton.** Limits maximum bandwidth to 20 MHz when activated, full bandwidth when off.

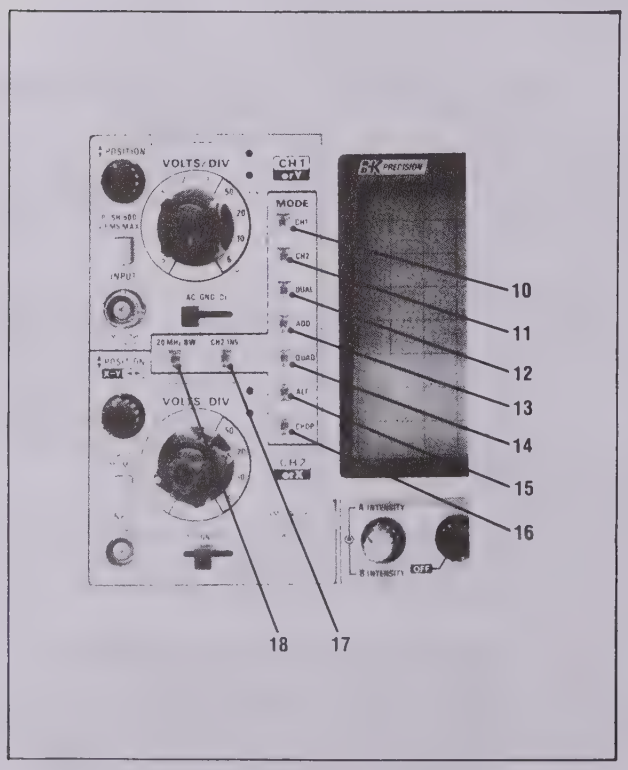


Fig. 7. Vertical Mode Selection Controls.

CHANNEL 1 CONTROLS
(refer to Fig. 8)

19. **INPUT Jack.** Vertical input for channel 1. Y axis input for X-Y operation.

> **CAUTION**
>
> Limit input to 5 volts maximum when 50 Ω termination is selected (Model 1590 only).

20. **PUSH 50 Ω Switch** (Model 1590 only). Terminates channel 1 input into 50 ohms when activated. Terminates channel 1 input into 1 megohm when off. Alternate action pushbutton switch; press to select 50 Ω, button latches in; press again to select 1 Megohm, button releases to out position.

21. ▲▼ **POSITION Control.** Rotation adjusts vertical position of channel 1 trace. In X-Y operation, rotation adjusts vertical position of display. Push-pull switch (**PULL X5 GAIN**) multiplies channel 1 vertical gain five times; for example, 5 mV/div sensitivity becomes 1 mV/div sensitivity.

22. **X5 GAIN Indicator** (Model 1590 only). Lights as reminder that channel 1 vertical gain is multiplied five times.

23. **UNCAL Indicator** (Model 1590 only). Lights as reminder that channel 1 vertical sensitivity is uncalibrated.

24. **VOLTS/DIV Control.** Vertical attenuator for channel 1. Provides step adjustment of vertical sensitivity. When channel 1 **VARIABLE** control is set to **CAL**, vertical sensitivity is calibrated in 10 steps from 5 mV/div to 5 V/div in a 1-2-5 sequence. Vertical sensitivity is five times greater when **X5 GAIN** is selected. In X-Y operation, this control provides step adjustment of Y-axis sensitivity.

25. **VARIABLE Control.** Rotation provides vernier adjustment of channel 1 vertical gain. In the fully clockwise (**CAL**) position, the vertical attenuator is calibrated. In X-Y operation this control becomes the vernier Y-axis gain control.

26. **AC-GND-DC Switch.** Three-position lever switch which operates as follows:

AC:
Channel 1 input signal is capacitively coupled; dc component is blocked.

GND:
Opens signal path and grounds input to vertical amplifier. This provides a zero-volt base line, the position of which can be used as a reference when performing dc measurements.

DC:
Direct coupling of channel 1 input signal; both ac and dc component of signal produce vertical deflection.

CHANNEL 2 CONTROLS
(refer to Fig. 9)

27. **INPUT Jack.** Vertical input for channel 2 in normal sweep operation. X-axis input in X-Y operation.

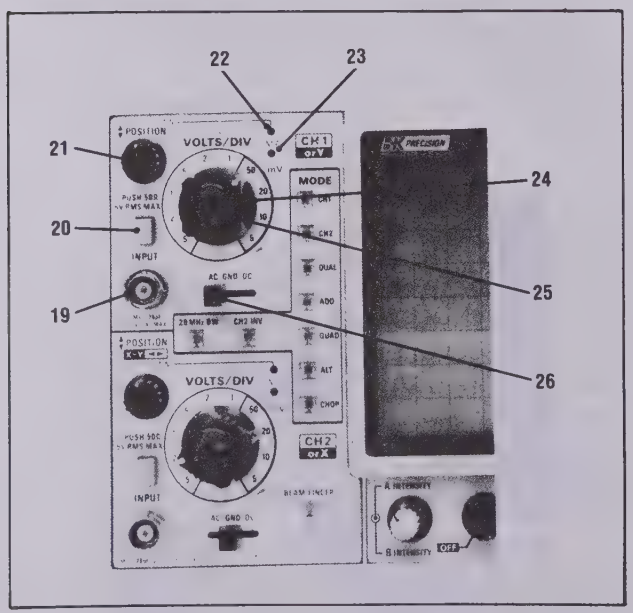


Fig. 8. Channel 1 Vertical Controls.

CAUTION

Limit input to 5 volts maximum when 50 Ω termination is selected (Model 1590 only).

28. **PUSH 50 Ω Switch** (Model 1590 only). Terminates channel 2 input into 50 ohms when activated. Terminates channel 2 input into 1 megohm when off. Alternate action pushbutton switch; press to select 50 Ω, button latches in; press again to select 1 megohm, button releases to out position.

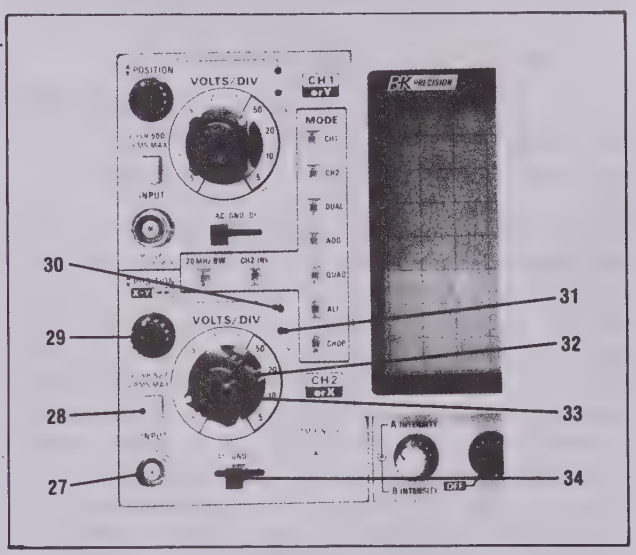


Fig. 9. Channel 2 Vertical Controls.

29. ▲▼ **POSITION Control.** Rotation adjusts vertical position of channel 2 trace. In X-Y operation, rotation adjusts horizontal position of display (**X-Y** ◄►). Push-pull switch (**PULL X5 GAIN**) multiplies channel 2 gain five times; for example, 5 mV/div sensitivity becomes 1 mV/div sensitivity.

30. **X5 GAIN Indicator** (Model 1590 only). Lights as reminder that channel 2 gain is multiplied five times.

31. **UNCAL Indicator** (Model 1590 only). Lights as reminder that channel 2 sensitivity is uncalibrated.

32. **VOLTS/DIV Control.** Vertical attenuator for channel 2. Provides step adjustment of vertical sensitivity. When **VARIABLE** control is set to **CAL,** sensitivity is calibrated in 10 steps from 5 mV/div to 5 V/div in a 1-2-5 sequence. Sensitivity is five times greater when **X5 GAIN** is selected. In X-Y operation, this control provides step adjustment of X-axis sensitivity.

33. **VARIABLE Control.** Rotation provides vernier control of channel 2 vertical sensitivity. In the fully clockwise (**CAL**) position, the attenuator is calibrated. In X-Y operation, this control becomes the vernier X-axis gain control.

34. **AC-GND-DC Switch.** Three-position lever switch which operates as follows:

AC:
Channel 2 input signal is capacitively coupled; dc component is blocked.

GND:
Opens signal path and grounds input to vertical amplifier. This provides a zero-volt base line, the position of which can be used as a reference when performing dc measurements.

DC:
Direct coupling of channel 2 input signal; both ac and dc component of signal produce vertical deflection.

HORIZONTAL CONTROLS

HORIZONTAL DISPLAY SELECTION
(refer to Fig. 10)

The **HORIZONTAL DISPLAY** switch assembly contains soft-touch pushbuttons (six on Model 1590, five on Model 1570) which are used to select the desired horizontal (sweep) mode. Each pushbutton is internally illuminated to show which mode is presently selected. All pushbuttons are electronically interlocked; i.e., selection of a new mode automatically releases the previous selection.

The **ALT, A-INT-B,** and **B DLY'D** modes are related to the **DELAY TIME MULTIPLIER** and **STARTS AFTER DELAY** controls. Refer to those controls for a description of that relationship.

35. **A Pushbutton.** Only the A sweep is operative, with the B sweep dormant.

36. **ALT Pushbutton.** A sweep (with B sweep superimposed as an intensified portion) alternates with B sweep.

37. **A-INT-B Pushbutton.** Duration of B sweep appears as an intensified portion on the A sweep.

38. **B DLY'D Pushbutton.** Only the delayed B sweep is operative.

39. **DUAL Pushbutton** (Model 1590 only). A sweep and B sweep operate independently. For this mode the two sweeps are triggered independently by the A trigger source and B trigger source respectively, and the **DELAY TIME MULTIPLIER** control has no effect. For **DUAL** operation, the A and B sweep alternate regardless of the **ALT** and **CHOP** switches. **DUAL** sweep operation is summarized at the end of this section.

40. **X-Y Pushbutton.** Selects X-Y mode. Channel 1 becomes the Y-axis and channel 2 becomes the X-axis. A sweep and B sweep are disabled. Settings of vertical **MODE** and **TRIG MODE** have no effect.

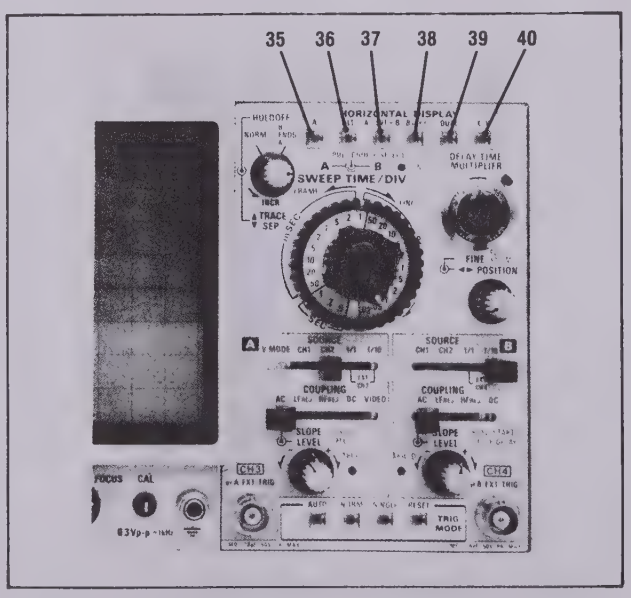


Fig. 10. Horizontal Mode Selection Controls.

SWEEP CONTROLS
(refer to Fig. 11)

The **A SWEEP TIME/DIV** and **B SWEEP TIME/DIV** controls are mechanically constructed so that it is impossible for the B sweep to operate at a slower sweep rate than the A sweep. There is no vernier adjustment for the B sweep.

41. **A SWEEP TIME/DIV Control.** Sweep time selector for A sweep. Provides step selection of sweep rate. When the **A VAR.** control is set to **CAL**, sweep rate is calibrated. Model 1590 has 23 steps of .02 µs/div to .5 s/div, and Model 1570 has 22 steps of .05 µs/div to .5 s/div, each in a 1-2-5 sequence.

42. **B SWEEP TIME/DIV Control.** Sweep time selector for B sweep. Provides step selection of sweep rate. Model 1590 sweep rate is calibrated in 20 steps from .02 µs/div to 50 ms/div, Model 1570 in 19 steps from .05 µs/div to 50 ms/div, each in a 1-2-5 sequence. In **A-INT-B** and **ALT** modes of **HORIZONTAL DISPLAY**, the duration of the intensified portion is dependent upon the **B SWEEP TIME/DIV** control setting.

43. **A VAR. Control.** Rotation of control is vernier adjustment for A sweep. In fully clockwise (**CAL**) position, sweep rate is calibrated.

    For Model 1590 only, this control also includes a push-pull switch (**PULL CHOP F. SELECT**) which provides a choice of two chop frequencies. In normal (pushed in) position, chop frequency is approximately 250 kHz. When pulled, the chop frequency is slightly shifted. This permits better viewing when signal being observed approaches the chop frequency or a sub-multiple. This switch is enabled only in the **CHOP** mode of dual-trace or quad-trace operation.

44. **Sweep UNCAL Indicator** (Model 1590 only). Lights to remind operator that the A sweep is uncalibrated.

45. **DELAY TIME MULTIPLIER Control.** Adjusts start time of B sweep to some delay time after the start of the A sweep. Delay time may be set from 0.2 to 10 times the setting of the **A SWEEP TIME/DIV** control. Calibrated control rotates almost 10 turns lock-to-lock. Number of full revolutions (0 to 10) appears in window of control. Fractional revolutions (100 parts per revolution) appears on skirt of control. Indicated sum of full and fractional revolutions is multiplication factor. Mechanical lock-unlock lever permits rotation of control or locks control to prevent accidental changing of setting.

    NOTE

    This control is enabled only in **ALT**, **A-INT-B**, and **B DLY'D** modes of **HORIZONTAL DISPLAY** in either **"STARTS AFTER DELAY"** or **"TRIGGERABLE AFTER DELAY"** operation. Refer to the **B SOURCE** and **B SLOPE** controls for a further description of that relationship.

46. **◄► POSITION Control.** Coarse horizontal position control.

47. **FINE Control.** Rotation of control is fine horizontal position adjustment. Push-pull switch selects ten times sweep expansion (**PULL 10X MAG**) when pulled out, normal when pushed in. Expands both A sweep and B sweep, increases maximum sweep rate to 2 ns/div for Model 1590, 5 ns/div for Model 1570.

48. **TRACE SEParation Control.** Adjusts vertical separation between A sweep and B sweep traces. Clockwise rotation increases separation (B sweep moves down with respect to A sweep).

    For Model 1570, the **TRACE SEP** control is enabled only in the **ALT** mode of **HORIZONTAL DISPLAY.**

    For Model 1590, the **TRACE SEP** control is enabled in the **ALT** mode of **HORIZONTAL DISPLAY,** and also in the **DUAL** mode of **HORIZONTAL DISPLAY** whenever vertical modes of **CH 1, CH 2,** or **ADD** are selected.

49. **HOLDOFF Control.** Rotation adjusts holdoff time (trigger inhibit period beyond sweep duration). Full clockwise rotation is **NORM.** Holdoff period increases progressively with counterclockwise rotation to maximum of about 5 times normal. Extreme counterclockwise rotation turns on switch (**B ENDS A**) which causes A sweep to terminate at end of B sweep. **B ENDS A** operation is enabled only in the **ALT** and **A-INT-B** modes of **HORIZONTAL DISPLAY.**

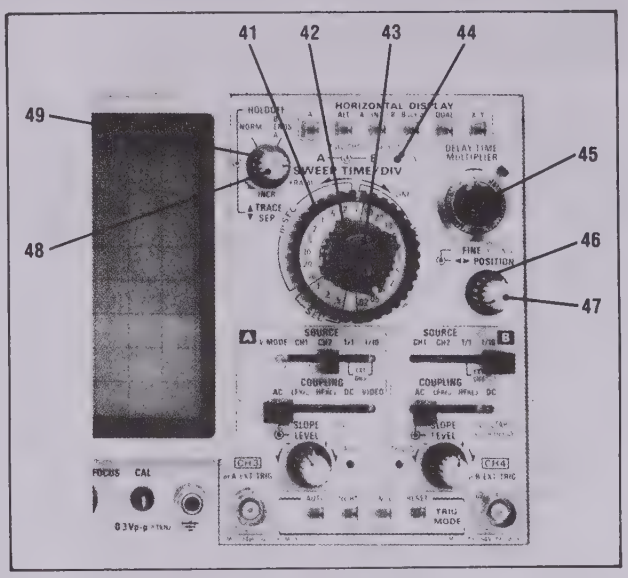


Fig. 11. Sweep Controls.

TRIGGERING CONTROLS

TRIGGER MODE SELECTION

(refer to Fig. 12)

The **TRIG MODE** switch assembly contains four soft-touch pushbuttons which are used to select the desired triggering mode. The **AUTO, NORM,** and **SINGLE** buttons are electronically interlocked so that only one of the three may be selected. Selecting a new trigger mode releases the previous selection. The face of each pushbutton is internally illuminated to show which triggering mode is presently selected. The **RESET** button is a momentary action switch used only in conjunction with the **SINGLE** mode.

50. **AUTO Pushbutton.** Selects automatic triggering mode. Generates sweep (free runs) in absence of trigger; automatically reverts to triggered sweep operation when adequate trigger signal is present. Auto triggering is applicable to both the A sweep and B sweep.

51. **NORM Pushbutton.** Selects normal triggered sweep operation, which generates a sweep only when adequate trigger signal is present. When scope is set up for multiple trigger sources, all trigger sources must be present to obtain a sweep.

52. **SINGLE Pushbutton.** Selects single sweep operation. For dual or quad trace display, single sweep operation requires **CHOP** method of display; do not select **ALT.** In single sweep operation, simultaneous observation of the A sweep and B sweep is not possible.

53. **RESET Pushbutton.** Enables single sweep operation. A single sweep will begin when the next sync trigger occurs. After a single sweep, **RESET** must be pressed again to enable next single sweep. Indicator (face of switch) lights to show that single sweep operation is ready for triggering. Lights when **RESET** switch is operated and remains lit until one sweep is completed.

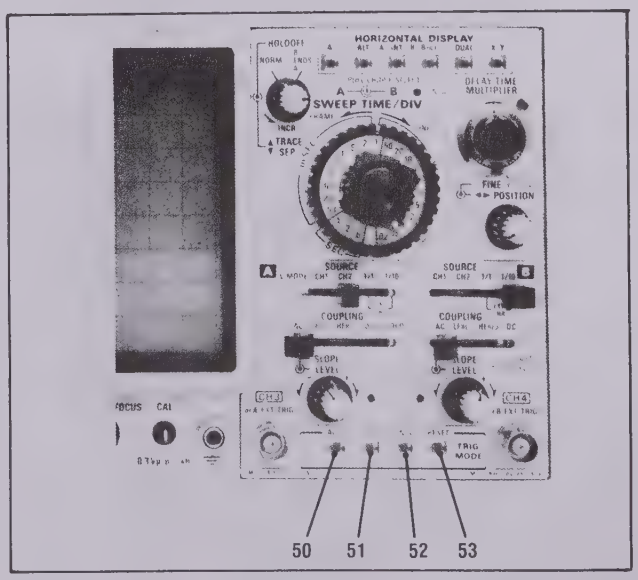


Fig. 12. Trigger Mode Selection Controls.

A SWEEP TRIGGERING CONTROLS
(refer to Fig. 13)

54. **SOURCE Switch.** Selects source of trigger for A sweep. Lever switch with the following positions:

V. MODE:
Triggering source for A sweep is selected by vertical **MODE** switch. Permits each waveform being viewed to become its own trigger signal. The relationship to the various vertical modes is as follows:

CH 1:
Channel 1 signal becomes the trigger source.

CH 2:
Channel 2 signal becomes the trigger source.

ADD:
The algebraic sum of CH 1 + CH 2 signals becomes the trigger source (CH 1 - CH 2 if channel 2 is inverted).

DUAL (ALT):
CH 1 and CH 2 signals alternate as the trigger source. Triggering is impossible unless input signals are applied to both CH 1 and CH 2.

QUAD (ALT):
CH 1 thru CH 4 signals alternate as the trigger source. Triggering is impossible unless input signals are applied to all four channels.

DUAL or QUAD (CHOP):
The display cannot be synchronized, since the chopping signal becomes the trigger source.

CH 1:
Channel 1 signal becomes A sweep trigger, regardless of vertical mode.

CH 2:
Channel 2 signal becomes A sweep trigger, regardless of vertical mode.

EXT CH 3 (Model 1570), or
1/1 (Model 1590):
Signal from **CH 3 or A EXT TRIG** jack becomes A sweep trigger, signal is unattenuated.

1/10 (Model 1590 only):
Selects signal from **CH 3 or A EXT TRIG** jack as trigger for A sweep, signal is attenuated 10:1.

55. **COUPLING Switch.** Selects trigger coupling for A sweep. Five-position lever switch with the following positions:

AC:
Trigger is capacitively coupled; dc component is blocked.

LF Rej:
Trigger is coupled thru high-pass filter. Frequencies below 30 kHz are attenuated.

HF Rej:
Trigger is coupled thru low-pass filter. Frequencies above 30 kHz are attenuated.

DC:
Trigger is direct coupled, and includes both the ac and dc component. Use for signals below 20 Hz. For CH 3 and CH 4, the vertical **POSITION** controls have no effect on the trigger point.

VIDEO:
Trigger is routed to video sync separator. Horizontal sync pulses are selected as trigger at sweep rates of 50 µs/div and faster (**LINE**). Vertical sync pulses are selected as trigger at sweep rates of .1 ms/div and slower (**FRAME**).

56. **TRIG'D Indicator.** Lights when A sweep is triggered.

57. **SLOPE Switch.** Two-position rotary switch. Counterclockwise position selects negative-going (–) slope and clockwise position selects positive-going (+) slope as triggering point for A sweep.

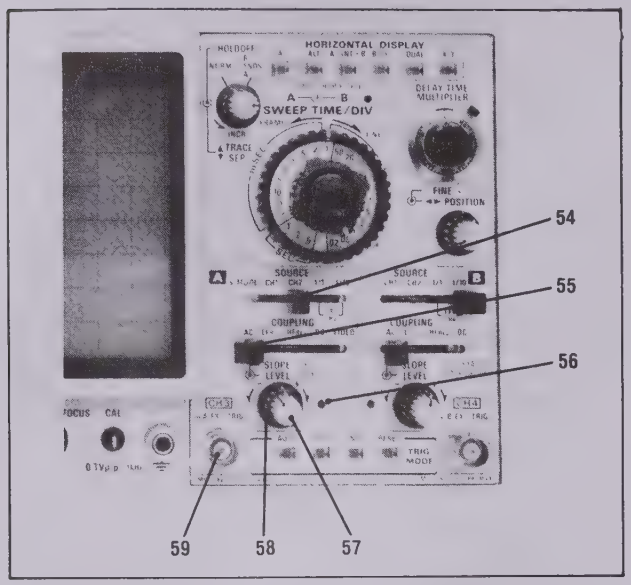


Fig. 13. A Sweep Triggering Controls.

For Model 1590 only, this control also includes a push-pull switch (**PULL FIX**). When pulled, the triggering level is automatically fixed at the average level of the triggering waveform, regardless of the setting of the **LEVEL** control. When pushed in, normal variable triggering level is enabled. Bandwidth of **FIX** operation is 40 Hz to 80 MHz.

58. **LEVEL Control.** Trigger level adjustment, determines point on triggering waveform where A sweep is triggered. Rotation in (-) direction selects more negative point of triggering, and rotation in (+) direction selects more positive point of triggering.

59. **CH 3 or A EXT TRIG Jack.** Vertical input for channel 3 in quad-trace operation. External trigger input for A sweep in single- and dual-trace operation.

B SWEEP TRIGGERING CONTROLS
(refer to Fig. 14)

60. **SOURCE Switch.** Selects the B sweep trigger source. Four-position lever switch has the following positions:

CH 1:
Channel 1 signal becomes B sweep trigger.

CH 2:
Channel 2 signal becomes B sweep trigger.

EXT CH 4 (Model 1570), or
1/1 (Model 1590):
Selects signal from **CH 4 or B EXT TRIG** jack as trigger for B sweep, signal is unattenuated.

1/10 (Model 1590 only):
Selects signal from **CH 4 or B EXT TRIG** jack as trigger for B sweep, signal is attenuated 10:1.

STARTS AFTER DELAY
(Model 1570 only):
Selects **"STARTS AFTER DELAY"** operation. The B sweep is triggered immediately after the delay set by the **DELAY TIME MULTIPLIER** control; the **B SLOPE** and **B LEVEL** controls have no effect.

NOTE

For Model 1570 only, the **CH 1, CH 2,** and **EXT CH 4** positions of the **SOURCE** switch are **"TRIGGERABLE AFTER DELAY"** modes. B sweep triggering is inhibited during the delay period (set by the **DELAY TIME MULTIPLIER** control); triggering occurs upon the first trigger signal after the delay period. Trigger signal conditions are established by the **B SOURCE, B SLOPE,** and **B LEVEL** controls. In the **AUTO** trigger mode, the unit will automatically revert to **"STARTS AFTER DELAY"** operation in the absence of a proper trigger signal.

61. **COUPLING Switch** (Model 1590 only). Selects trigger coupling for B sweep. Four-position lever switch has the following positions:

AC:
Trigger is capacitively coupled; dc component is blocked.

LF Rej:
Trigger is coupled thru high-pass filter. Frequencies below 30 kHz are attenuated.

HF Rej:
Trigger is coupled thru low-pass filter. Frequencies above 30 kHz are attenuated.

DC:
Trigger is direct coupled, and includes both the ac and dc component. Use for signals below 20 Hz.

NOTE
For Model 1570, the B trigger is always AC coupled.

62. **CH 4 or B EXT TRIG Jack.** Vertical input for channel 4 in quad-trace operation. External trigger input for B sweep in single- and dual- trace operation.

63. **SLOPE Switch.** Two-position rotary switch. Counterclockwise position selects negative-going (-) slope and clockwise position selects positive-going (+) slope as triggering point for B sweep.

For Model 1590 only, this control also includes a push-pull switch (**PULL - STARTS AFTER DELAY**), which operates as follows:

"STARTS AFTER DELAY" OPERATION (knob pulled):
The B sweep is triggered immediately after the delay period (delay period is set by the **DELAY TIME MULTIPLIER** control). The **B SOURCE, B COUPLING, B SLOPE,** and **B LEVEL** controls have no effect.

"TRIGGERABLE AFTER DELAY" OPERATION (knob pushed in):
B sweep triggering is inhibited during the delay period; triggering occurs upon the first trigger signal after the delay period. Trigger signal conditions are set by the **B SOURCE, B COUPLING, B SLOPE,** and **B LEVEL** controls. In the **AUTO** trigger mode, the unit will automatically revert to **"STARTS AFTER DELAY"** operation in the absence of a proper trigger signal.

NOTE
STARTS AFTER DELAY or **TRIGGERABLE AFTER DELAY** operation is applicable only in the **ALT, A-INT-B,** and **B DLY'D** modes of **HORIZONTAL DISPLAY.**

64. **LEVEL Control.** Trigger threshold level adjustment. Determines point on triggering waveform where B sweep is triggered. Rotation in (-) direction selects more negative point of triggering, and rotation in (+) direction selects more positive point of triggering.

65. **TRIG'D Indicator.** Lights when B sweep is triggered. This indicator does not light in **"STARTS AFTER DELAY"** operation.

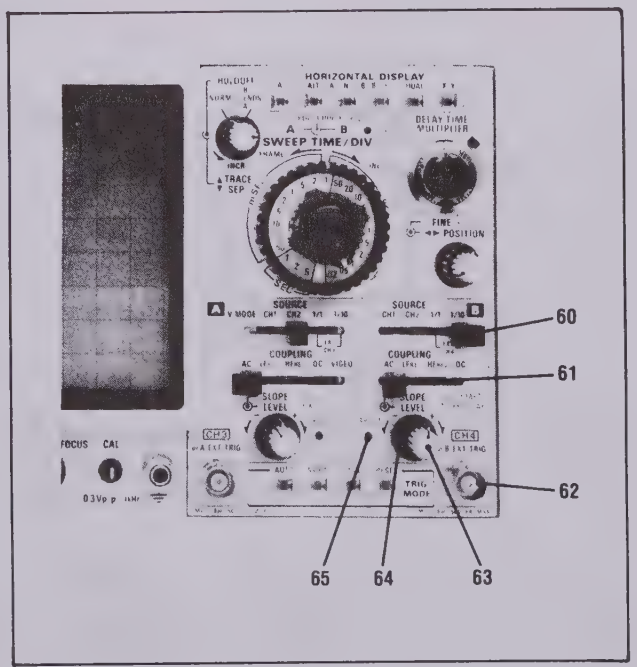


Fig. 14. B Sweep Triggering Controls.

OTHER CONTROLS

SIDE PANEL CONTROLS
(refer to Fig. 15)

66. **CH 3 POSITION Control.** Vertical position adjustment for channel 3 trace.

67. **CH 4 POSITION Control.** Vertical position adjustment for channel 4 trace.

REAR PANEL CONTROLS
(refer to Fig. 15)

68. **CAL 1 kHz 10 mA Loop** (Model 1590 only). Calibration loop for current probe. Arrow indicates direction of positive polarity.

69. **A GATE Jack** (Model 1590 only). Output terminal where gate waveform coincident with A sweep is available. Gate waveform is approximately 1.5 volt positive with 0 volt reference, output impedance is approximately 500 ohms.

70. **B GATE Jack** (Model 1590 only). Output terminal where gate waveform coincident with B sweep is available. Gate waveform is approximately 1.5 volt positive with 0 volt reference, output impedance is approximately 500 ohms.

71. **CH 1 OUT Jack.** Output terminal where sample of channel 1 signal is available. Amplitude is 50 millivolts per division of vertical deflection seen on CRT when terminated into 50 ohms. Output impedance is 50 ohms.

72. **Z AXIS INPUT Jack.** Input jack for intensity modulation of CRT electron beam. TTL compatible (5 volts p-p sensitivity). Positive-going signal increases intensity.

73. **Power Cord Receptacle.**

74. **Line Voltage Switch.** Selects **90-132 V** or **180-264V** ac line voltage. A reversible locking plate holds this slide switch in the appropriate position.

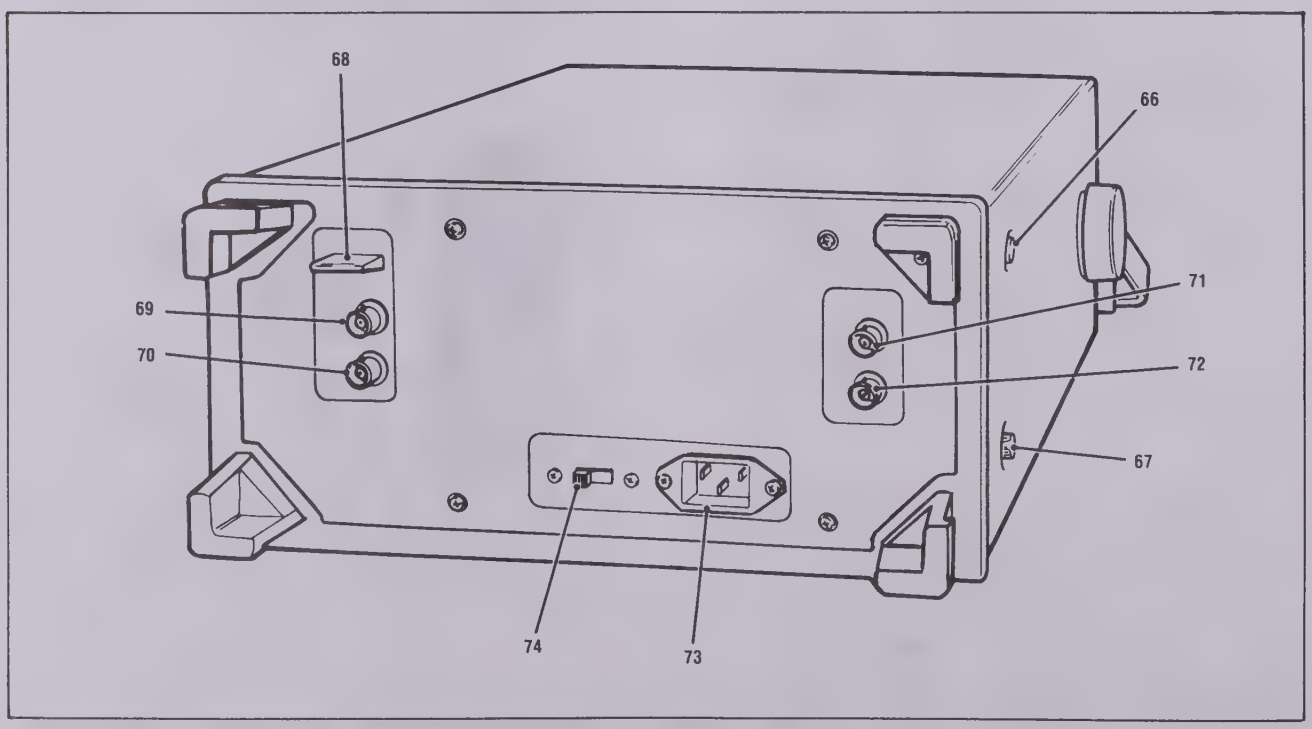


Fig. 15. Side and Rear Panel Controls.

BOTTOM PANEL CONTROLS
(refer to Fig. 16)

75. **TRACE ROTATION Control.** (accessible through hole in bottom cover) Adjusts trace to horizontal position.

76. **ASTIG Control.** (accessible through hole in bottom cover). Provides optimum spot roundness; used in conjunction with **FOCUS** and **INTENSITY** controls.

77. **Feet/Cord Wrap.**

78. **Handle/Tilt Stand.**

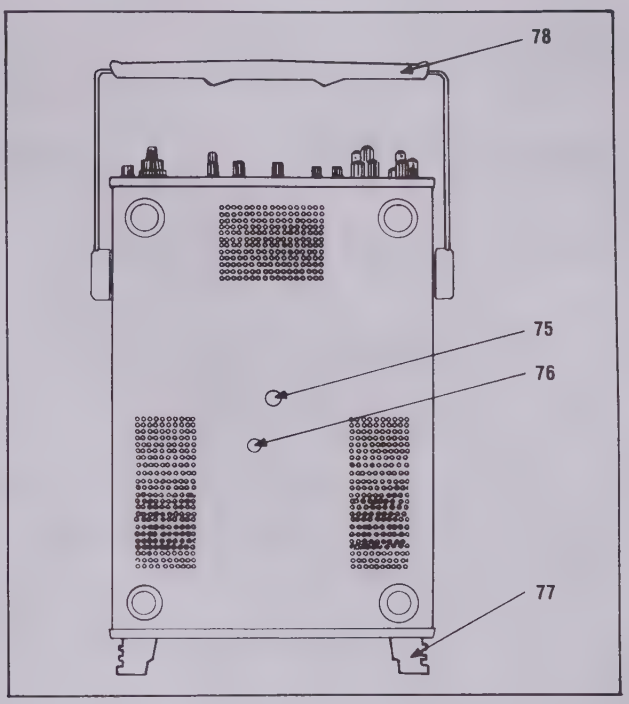


Fig. 16. Bottom Panel Controls.

SUMMARY OF DUAL SWEEP OPERATION
(Model 1590 only)

INTRODUCTION

When the **DUAL** mode of **HORIZONTAL DISPLAY** is selected, the instrument essentially operates as two independent 100 MHz scopes. The A sweep and B sweep are independently triggered as well as having independent sweep times. This permits two unrelated signals to be observed at the same time if desired.

The versatility of the scope permits every possible combination of vertical **MODE**, trigger **A SOURCE**, and trigger **B SOURCE** to be selected. However, synchronization of the display is not possible with some of these combinations unless the signals are time related. Operation of the **DUAL** sweep mode is summarized in the following tables; use both tables, the first for A sweep operation and the second for B sweep operation.

PROCEDURE

1. Select **DUAL** mode of **HORIZONTAL DISPLAY** (in this mode, alternate sweep method is used, regardless of setting of **ALT** and **CHOP** switches).

2. Select **AUTO** mode of triggering.

3. Select vertical **MODE, A SOURCE,** and **B SOURCE** settings from following tables for desired operation.

4. Adjust **A TRIG LEVEL, B TRIG LEVEL, A SWEEP TIME/DIV,** and **B SWEEP TIME/DIV** independently as required.

A SWEEP

A SOURCE	Vertical MODE					
	CH 1	CH 2	DUAL	ADD	QUAD	
V MODE	CH 1	CH 2	CH 1, CH 2	CH 1 + CH 2	CH 1 - CH 4	Trigger Source
	CH 1	CH 2	CH 1 Note 1	CH 1 + CH 2	CH 1, CH 3 Note 2	CRT Display
CH 1	CH 1	CH 1	CH 1	CH 1	CH 1	Trigger Source
	CH 1	CH 2 Note 3	CH 1	CH 1 + CH 2	CH 1, CH 3 Note 4, 5	CRT Display
CH 2	CH 2	CH 2	CH 2	CH 2	CH 2	Trigger Source
	CH 1 Note 3	CH 2	CH 1 Note 3	CH 1 + CH 2 Note 3	CH 1, CH 3 Note 3, 5	CRT Display
EXT CH 3	CH 3	CH 3	CH 3	CH 3	CH 3	Trigger Source
	CH 1 Note 5	CH 2 Note 6	CH 1 Note 5	CH 1 + CH 2 Note 5, 6	CH 1, CH 3 Note 5, 7	CRT Display

B SWEEP

B SOURCE	Vertical MODE					
	CH 1	CH 2	DUAL	ADD	QUAD	
CH 1	CH 1	CH 1	CH 1	CH 1	CH 1	Trigger Source
	CH 1	CH 2 Note 3, 8	CH 2 Note 3	CH 1 + CH 2 Note 3	CH 2, CH 4 Note 3, 9	CRT Display
CH 2	CH 2	CH 2	CH 2	CH 2	CH 2	Trigger Source
	CH 1 Note 3, 8	CH 2	CH 1	CH 1 + CH 2	CH 2, CH 4 Note 10	CRT Display
EXT CH 4	CH 4	CH 4	CH 4	CH 4	CH 4	Trigger Source
	CH 1 Note 11	CH 2 Note 9	CH 2 Note 9	CH 1 + CH 2 Note 9, 11	CH 2, CH 4 Note 12	CRT Display

NOTES:

1. A sweep is triggered alternately from CH 1 and CH 2, but only the CH 1 signal is displayed.
2. A sweep is triggered alternately by CH 1 thru CH 4, but only the CH 1 and CH 3 signals are displayed.
3. Sync not possible if there is no time relationship between CH 1 and CH 2 signals.
4. A sweep is triggered by CH 1 signal and CH 1 and CH 3 signals are displayed.
5. There must be a time relationship between CH 1 and CH 3 signals.
6. Sync not possible if there is no time relationship between CH 2 and CH 3 signals.
7. A sweep is triggered by CH 3 signal and CH 1 and CH 3 signals are displayed.
8. A sweep must be triggered.
9. There must be a time relationship between CH 2 and CH 4 signals.
10. B sweep is triggered by CH 2 signal and CH 2 and CH 4 signals are displayed.
11. Sync not possible if there is no time relationship between CH 1 and CH 4 signals.
12. B sweep is triggered by CH 4 signal and CH 2 and CH 4 signals are displayed.
13. A sweep must be triggered.

CIRCUIT DESCRIPTION

Unless otherwise stated, all information in this section applies equally to Model 1570 and 1590. Shaded areas highlight differences between models.

GENERAL

Refer to Fig. 23 at the end of this section for a block diagram of the oscilloscope, and to the schematic diagrams for more detailed circuit analysis. Reference to the corresponding schematic diagram is recommended while reading this section. Refer to the interconnect diagram for interconnections from one board to another and for chassis-mounted parts such as the input and output connectors and some of the front panel controls that are not mounted on circuit boards.

VERTICAL ATTENUATOR CIRCUIT BOARD

Input Circuit

The channel 1 and channel 2 input circuits are mounted on the front panel, and are shown on the interconnect diagram. This includes the channel 1 and channel 2 AC-GND-DC switches S25 and S26.

For Model 1590 only, PUSH 50Ω switches S23 and S24 are also mounted on the front panel.

Vertical Attenuator Circuit

Refer to the schematic diagram. The basic sensitivity of the vertical amplifier is 5 mV per division. Higher amplitude input signals are attenuated to the 5 mV/division level before application to the vertical preamplifier. This is accomplished in a three section attenuator (VOLTS/DIV control), which maintains a 1 Megohm input resistance while reducing the input signal level through precision voltage dividers.

The first attenuator section has 1:1 and 10:1 steps, the second section 1:1 and 100:1 steps, and the third section 1:1, 2:1, and 4:1 steps. In various combinations, this provides 10 steps of attenuation from 5 mV/ division to 5 V/division as summarized in Table 1. The attenuator itself uses only passive components (resistors and capacitors); this eliminates the need for amplifier balancing found in most other attenuator designs.

The signal from the attenuator is applied to a dual FET impedance conversion circuit, Q1. This circuit has excellent stability vs temperature characteristics, resulting in good dc balance. The output of Q1 is applied to hybrid amplifier IC12. This hybrid consists of a ceramic substrate which mounts transistors and RC components, keeping all components at the same temperature for good dc balance. The output of IC12 is applied to the vertical preamplifier. VR3 is the VARIABLE control, which adjusts the output level through an attenuator pad. This provides better frequency response than variable gain.

The circuit for channel 2 is the same as channel 1.

The vertical attenuator board is almost identical for Model 1570 and 1590. However, only the Model 1590 includes S3 and S4, the switch contacts which activate the UNCAL indicators.

VOLTS/DIV	SECTION 1	SECTION 2	SECTION 3	TOTAL
5 mV/div	1:1	1:1	1:1	1:1
10 mV/div			2:1	2:1
20 mV/div			4:1	4:1
50 mV/div	10:1	1:1	1:1	10:1
0.1 V/div			2:1	20:1
0.2 V/div			4:1	40:1
0.5 V/div	1:1	100:1	1:1	100:1
1 V/div			2:1	200:1
2 V/div			4:1	400:1
5 V/div	10:1	100:1	1:1	1000:1

Table 1. Summary of Vertical Attenuator Operation.

CH1~CHOP MODE

"MODE" PUSH	Qt				Qt + 1															
	IC3a IN OUT			IC6 CK	CH1 / CH2 / ADD						IC6 Q2	DUAL QUAD				ALT CHOP				
	IN Pin 5	IN Pin 6	OUT Pin 4		IC6			IC5				IC4a Q	IC6 Q0	IC9 OUTPUT		IC4b Q	IC6 Q1	IC9 OUTPUT		
					Q5	Q4	Q3	a	b	c				b	a			c	d	
CH1	L	⌐	⌐	⌐	H	L	L	L	H	H	H	X	X	H	H	X	X	H	H	
CH2	L	⌐	⌐	⌐	L	H	L	H	L	H	H	X	X	H	H	X	X	H	H	
DUAL	⌐	L	⌐	⌐	L	L	L	H	H	H	L	L	L	L	H	X	X	X	X	
ADD	L	⌐	⌐	⌐	L	L	H	H	H	L	H	X	X	H	H	X	X	H	H	
QUAD	⌐	L	⌐	⌐	L	L	L	H	H	H	L	H	H	H	L	X	X	X	X	
ALT	⌐	L	⌐	⌐	L	L	L	H	H	H	L	X	X	X	X	H	L	L	H	
CHOP	⌐	L	⌐	⌐	L	L	L	H	H	H	L	X	X	X	X	L	H	H	L	

CH2 INV.

	Qt	Qt + 1
CH2 INV PUSH	IC10a INPUT	IC10a OUTPUT
	(T)	(Q)
	⌐	Y

20MHz B.W.

	Qt	Qt + 1
20MHz B W PUSH	IC 10b INPUT	IC10b OUTPUT
	(T)	(Q)
	⌐	Y

Qt = Logic level when switch is pressed.
Qt + 1 = Logic level after switch is pressed (selection latched).
X = H or L, Logic level doesn't change from previous state
Y = H or L, but opposite logic level from previous state.

Fig. 17. Vertical Mode Selection Logic Circuit Summary.

Vertical Mode Selection Circuit

A substantial portion of the vertical mode selection circuits are located on the vertical attenuator board. Refer to the schematic diagram and the vertical mode selection logic circuit summary of Fig. 17. The MODE select switches on the front panel are momentary action pushbutton switches. These momentary action switches generate a single pulse output that is applied to the electronic mode switching network, which effectively converts the momentary action switches to latching type.

Whenever a front panel vertical MODE switch is pressed, the input to a Schmitt trigger (IC1a-f or IC2f) is pulled low. The RC network in each Schmitt trigger input circuit serves as a contact debounce circuit by holding the input low (below the Schmitt trigger conduction threshold) for a finite period of time. Thus, operating a pushbutton switch produces a positive pulse at the output of one of the Schmitt triggers.

For CH 1, CH 2, or ADD modes, the pulse from the corresponding Schmitt trigger is applied directly to latch register IC6 (inputs D3, D4, or D5). This pulse is also applied through diode D9, D10, or D11 to NAND gate IC3b and into an RC delay network in the input of IC2c. This delayed pulse is applied through IC2c and IC7a to the clock input of IC6. The delay assures that the "D" input of IC6 has reached the high logic state and stabilized before the clock input is applied. IC6 latches the mode selection; i.e., the "D" input states are transferred to the corresponding "Q" outputs at the instant of the clock pulse. The "Q" outputs remain latched in that state until another mode is selected.

The Q3, Q4, or Q5 output of IC6 drives the LED indicator in the face of the corresponding CH1, CH 2, or ADD pushbutton through drivers IC8 and IC5. Of course, the outputs of the drivers are also available at connector P5, from which they are routed to the vertical preamplifier board. There, these control signals select which vertical amplifiers are to be enabled.

The D2 input of IC6, and its corresponding Q2 output, enable or disable the DUAL, QUAD, CHOP, and ALT select circuits. When the CH 1, CH 2, or ADD mode is selected, the Q2 output is placed in the disable state as follows. In addition to the circuit paths previously described, the pulse from the Schmitt trigger is applied through diode D9, D10, or D11 directly to the D2 input of IC6. When IC6 is clocked, this results in a high logic level (disabled condition) at the Q2 output of IC6. In turn, this cancels or prevents selection of the DUAL or QUAD mode (and its corresponding ALT or CHOP sub-mode) via logic circuits IC8c, IC11a and b, and IC9a, b, c, and d.

To select the DUAL and QUAD modes, the pulse from the corresponding Schmitt trigger is applied to IC4a. The RC delay circuit in the clock input of IC4a delays the clock input until the high logic level is present and stabilized on the J or K input. IC4a latches the selection; for the DUAL mode the Q output of IC4a is low, and for the QUAD mode it is high. This signal is then applied to the D0 input of IC6. IC6 is clocked as described previously, via diode D7 or D8 (the delay in the IC6 clock input is longer than the delay in the IC4a clock input). The Q0 output of IC6 is either high or low, depending upon the selected mode, and is gated through IC8a. The Q2 output of IC6 is now in the logic low state (enabled condition); thus, IC8c allows the selected DUAL or QUAD mode to be gated through IC9a or b.

Whenever the DUAL or QUAD mode is selected, either the CHOP or ALT sub-mode will be simultaneously selected, whichever was last selected. The CHOP or ALT selection is made and latched into IC4b (circuit operation is the same as described for DUAL or QUAD selection in IC4a). This produces either a high or low logic state on the Q1 output of IC6, depending upon the selected mode, which is gated through IC8b. Again, IC8c allows either IC9c or d to be gated, thus selecting CHOP or ALT operation.

CH 2 Invert Circuit

Each time the CH 2 INV pushbutton on the front panel is pressed, the opposite operating

condition is selected; i.e., press once for on, press again for off. The CH 2 INV circuit operates independently from other mode selection circuits. The input Schmitt trigger circuit, IC2d, operates the same as described for other vertical mode selection circuits, producing a positive pulse at the "T" input of IC10a. IC10a is strapped so that the output changes state with each input pulse and latches that selection until the next pulse is applied.

20 MHz Bandwidth Selection Circuit

Limiting the bandwidth to 20 MHz is selected by another independently operating circuit, IC10b, which alternately selects the on and off condition. It operates exactly like the CH 2 INV selection circuit just described.

Mode Selection Memory

The vertical mode selections are retained in memory when ac power is turned off. The scope will still be in the last selected mode when it is again turned on. This is accomplished by powered the mode selection latch circuits when the power supply is turned off. IC4 thru IC11, which are very low current drain CMOS integrated circuits, are powered from $+V_M$ (memory voltage source). V_M is a +5 volt supply voltage from the power supply when it is operating. When ac power is removed, a battery (for Model 1590) or storage capacitor (for Model 1570) continues to power the circuit. The battery or storage capacitor is located on the horizontal mode control board, where it similarly powers the horizontal and trigger mode selection circuits.

VERTICAL PRE-AMPLIFIER BOARD

Input Amplifier

Refer to the schematic diagram. This oscilloscope has four preamplifier circuits to allow 4-channel operation. The output of the channel 1 vertical attenuator is fed to IC1, an amplifier. The amplifier provides good dc balance by use of a transistor array used to stabilize gain. The array is thermally linked to the amplifier to achieve this goal. The gain of the channel 1 preamplifier is calibrated by VR3, while VR4 centers the adjustment range of the front panel CH 1 POSITION control. Transistors Q2 and Q3 form the channel 1 position circuit. This preamplifier varies base potential to eliminate the effect of lead inductance.

For channel 2, an inverting stage in IC2 provides normal or inverted output of that channel. Transistor switches Q46-Q49 select the normal or inverted polarity output of IC2, with VR15 compensating for any vertical position imbalance when the inverted polarity is selected. Q50 and Q51 form the channel 2 position circuit which operates in a similar fashion to channel 1.

X1 and X5 Gain Amplifiers

Transistors Q4 and Q5 are the x1 amplifier stages for channel 1, and Q6 and Q7 are the x5 amplifier. Gain calibration for the x5 amplifier is set by VR6, and VR5 corrects for any vertical position offset when x5 gain opertion is selected. The circuit formed by Q8 and Q9 is used to switch between x1 and x5 gain for channel 1. For channel 2, the x1 amplifier consists of Q52 and Q53, the x5 amplifier is Q54 and Q55, and the gain switch is formed by Q56 and Q57. In this oscilloscope, the bandwidth is not decreased when x5 gain operation is selected, since the bandwidth limitations occur in the vertical output amplifier, not in the preamplifier.

Switched Amplifiers

Transistors Q10 and Q11, along with Q19 and Q20, form a cascode amplifier. Q18 and Q21 operate in conjunction with Q19 and Q20 to turn the channel 1 signal on and off. Similar functions for channels 2 are performed by Q58/Q59, Q65/Q66, and Q64/Q67. In the DUAL (ALT) vertical mode, for example, the channel 1 and channel 2 preamplifier outputs are alternately switched on in synchronization

with the sweep. The specific channels to be switched on at a given time are controlled by the vertical mode logic circuits on this board.

Trigger Amplifier

The channel 1 trigger amplifier is made up of Q12 and Q13. The trigger signal passes through the buffer output amplifier formed by Q14 and Q15, where it is converted to a 50Ω impedance and sent to the A and B trigger SOURCE switches. The similar trigger circuit for channel 2 includes Q60-Q63.

External CH 1 Output

For channel 1 only, the vertical signal is available to the rear panel CH 1 OUTPUT connector, driven by Q16 and Q17. This signal preceeds the switching amplifiers and is available whether the channel 1 signal is displayed or not.

Channel 3 and 4

The circuit configuration for the channel 3 and 4 preamplifiers is the very similar to that described for channels 1 and 2, except that the POSITION controls (VR1 and VR2) are mounted directly on the circuit board.

Output Stage

The gated outputs of channels 1 thru 4 are applied to a common point, the base of emitter followers Q42 and Q43. This vertical output signal is amplified by Q44 and Q45, which is a feedback amplifier with excellent common mode rejection. The output of Q44/Q45 is fed to the delay line.

Through the action of the vertical mode logic circuit and the switched amplifiers, the signal from only one channel is present at a given time (except in the ADD mode, when channel 1 and 2 signals are simultaneously gated). In the QUAD (ALT) mode, for example, the channel 1 thru 4 preamplifier outputs are sequentially gated to the output stage in synchronization with the sweep.

V MODE Trigger Source

Transistors Q38/Q39 and Q40/Q41 form the trigger amplifier which sends the signal of the output stage to the A trigger SOURCE switch as the V. MODE trigger source. This allows the signals being observed to become the trigger source, and it automatically follows any change in vertical mode selection. In DUAL and QUAD modes, this permits stable triggering of all waveforms, even when they are not time related.

ADD Mode Compensator

In the ADD mode, the channel 1 and channel 2 preamplifiers are simultaneously switched on, and gain must be reduced accordingly so that the vertical deflection sensitivity still equals that indicated by the VOLTS/DIV control. This is achieved by transistor switch Q37, which halves the load resistance of the channel 1 and 2 preamplifiers in the ADD mode.

Bandwidth Limit Switch

Q33 thru Q36 form the 20 MHz bandwidth switch circuit, which limits the vertical amplifier bandwidth to about 20 MHz by switching in C25 and C26.

Vertical Control Logic

The channel 1 thru 4 signals are switched by logic circuits IC3-IC7 in accordance with the vertical mode and horizontal mode selected. Operation of the circuit can best be analyzed by reviewing the relationship of the vertical display to the selected modes. Fig. 18 summarizes the logic states for the various modes of operation.

			MODE INPUT (P5)					VERTICAL CLOCK (P14)					FLIP-FLOP PRESET. CLEAR signal			FLIP-FLOP OUTPUT signal				CHANNEL SELECT signal			
			CH1	CH2	DUAL	ADD	ALT	ALT/CHOP	Single/plu	CP	DS	CO	IC5b R	IC5b S	IC5a R	IC5b Q	IC5b $\bar{Q}$	IC5a Q	IC5a $\bar{Q}$	CH1	CH2	CH3	CH4
SWEEP OPERATION	Except DUAL SWEEP	CH1	L	H	H	H	H	L	L	L	L	X	L	H	L	L	H	L	H	H	L	L	L
		CH2	H	L	H	H	H	L	L	L	L	X	H	L	L	H	L	L	H	L	H	L	L
		ADD	H	H	H	L	H	L	L	L	L	X	L	L	L	H	H	L	H	H	H	L	L
		DUAL ALT	H	H	L	H	L	L	H	⎍⎍	⎍⎍	L	H	H	L	TOGGLE		L	H	Fig. A		L	L
		DUAL CHOP					H	H															
		QUAD ALT			H		L	L							H	TOGGLE		TOGGLE		Fig. B			
		QUAD CHOP					H	H															
	DUAL SWEEP	DUAL ALT	H	H	L	H	L	L	H	⎍⎍	⎍⎍	H	L	L	L	H	H	L	H	Fig. C		L	L
		DUAL CHOP					H	H															
		QUAD ALT			H		L	L							H	H	H	TOGGLE		Fig. D			
		QUAD CHOP					H	H															
X-Y operation			X	X	X	X	X	X	H	H	L	L	L	H	L	L	H	L	H	H	L	L	L

(Note) "X" H or L
CP signal is CHOP signal, or coincident with sweep for ALT.

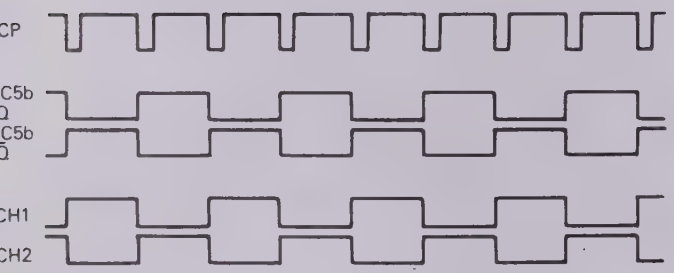


Fig. A. (Synchronized with the CP signal regardless of the DS signal)

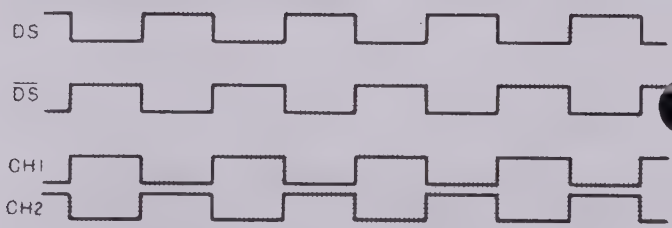


Fig. C. (Synchronized with DS signal regardless of the CP signal)

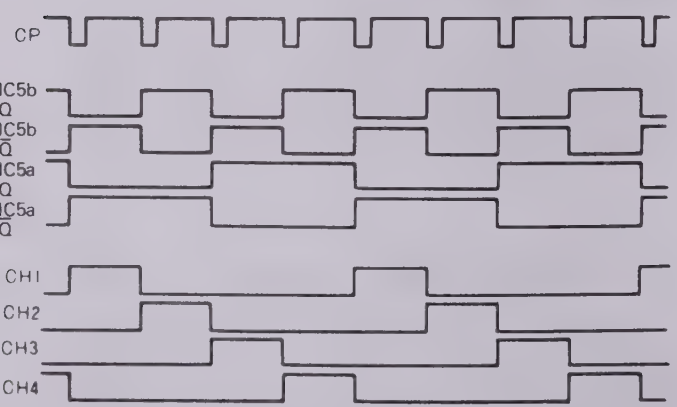


Fig. B. (Synchronized with CP signal regardless of the DS signal)

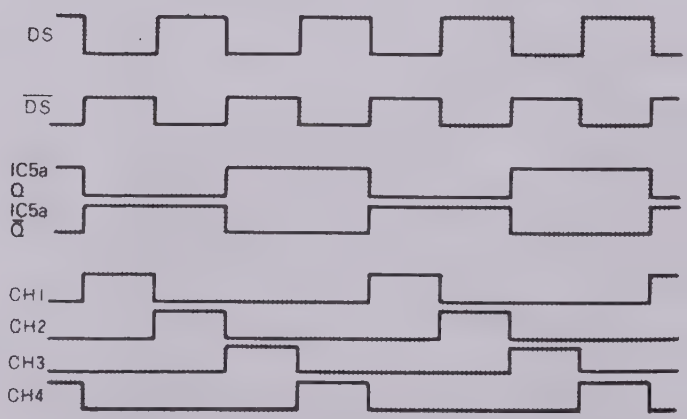


Fig. D. (Synchronized with DS signal regardless of the CP signal)

Fig. 18. Vertical Control Logic Circuit Summary.

VERTICAL OUTPUT AMPLIFIER

A delay line between the vertical preamp and the vertical output amplifier delays the vertical signal in comparison to the trigger signal so that the leading edge of high speed waveforms is visible. A visible delay of at least 20 ns (Model 1570) or 30 ns (Model 1590) is provided by this delay line.

Refer to the schematic diagram. The signal from the delay line is applied to the vertical output amplifier at Q1 and Q2. Q1-Q4 form a cascode differential input amplifier. Q11 forms a bias current stabilization circuit. The final output amplifier stage is made up of Q7-Q10 and Q13/Q14.

The vertical trace separation circuit includes Q5. In the ALT mode of horizontal display (and in certain DUAL sweep combinations for Model 1590), the trace separation input signal alternates between two levels in synchronization with the A sweep and B sweep periods. During the B sweep period, the output of Q5 effectively shifts the vertical position of the trace with respect to the A sweep period. The amplitude of the trace separation input signal is dependent upon the setting of the front panel TRACE SEP control.

On Model 1590 only, Q12 serves to shrink vertical deflection whenever the BEAM FINDER pushbutton is held closed. This is accomplished by shunting the emitter resistance of Q11 through Q12.

A TRIGGER SWITCH CIRCUIT BOARD

The channel 1, 2, 3 and V MODE signals are sent to the A Trigger Switch board from the vertical preamp board. Refer to the A Trigger Switch board schematic. Switch S1 is the trigger SOURCE switch and S2 is the trigger COUPLING switch. In Model 1570, SOURCE switch S1 is a single section, 4-position switch, which selects the channel 1, channel 2, external/channel 3, or V MODE signal as the trigger source for the A sweep generator. In Model 1590, a fifth position also selects the external/channel 3 signal, but the second section of the switch selects the channel 3 10:1 attenuator. The second switch section routes +10 volts to the relay driver on the horizontal mode control circuit board which switches in the 10:1 attenuator in the channel 3 input circuit.

COUPLING switch S2a and b offers capacitive coupling in the AC position, a high pass filter in the LF REJ position, a low pass filter in the HF REJ position, and direct coupling in the DC position. Sections S2c and d bypass the video sync separator circuit except in the VIDEO position.

Q5 acts as a Schmitt trigger. TRIG LEVEL control VR1 sets a variable dc threshold on Q5b. When the signal applied at Q5a exceeds this threshold, a sharp trigger edge is developed. As the signal drops back below the threshold, a sharp trigger edge in the opposite direction is developed. Dual FET trigger amplifier Q5 offers a very high input impedance and exhibits very small temperature drift, even for dc coupled inputs. Q6 and Q7 are an emitter follower configuration and provide good impedance matching between the FET and the next amplifier stage. Q8 and Q9 are feedback amplifiers with good common mode rejection characteristics. IC1 is a cascode amplifier with normal or inverted output. SLOPE switch S4 selects the desired polarity. The output of IC1 is applied to the final output stage Q10, which is an impedance conversion circuit. Q10 provides a 50Ω output impedance to drive the horizontal sweep circuit board.

Q3 and Q4 form the VIDEO sync circuit. Q3 detects sync pulses from the positive side of a composite video signal and ignores the negative video component. At FRAME sweep speeds, Q4 is turned on to connect C8 into the circuit, which shunts the faster horizontal (line) sync pulses but allows the slower vertical (frame) sync pulses to pass. At LINE sweep speeds, Q4 is turned off, C8 is disconnected, and the horizontal sync pulses pass.

Model 1590 also includes the FIX synchronization circuit, Q1 and Q2. When this circuit is selected by pulling PULL FIX switch S3, the TRIG LEVEL control is disconnected from Q5 and the circuit of Q1 and Q2 detect and filter the average dc level of the source signal and use it as the trigger threshold. This acts as an automatic triggering level, since the circuit fixes the triggering level at the center of the waveform regardless of variations in the waveform.

B TRIGGER SWITCH CIRCUIT BOARD

Basically, this circuit operates almost the same as the A Trigger Switch circuit board just described except that it does not include a video sync separator circuit or FIX synchronization circuit. The channel 1, 2, and 4 signals are available as the triggering source, or a STARTS AFTER DELAY mode may be selected wherein the B Trigger Switch board output is not used. The channel 2 input is amplified by Q1 for use in the X-Y mode.

Model 1570 is always ac coupled and does not include COUPLING switch S2. In Model 1590, SOURCE switch S1b controls the channel 4 attenuator and push-pull switch S4 controls the STARTS AFTER DELAY function. For Model 1570, S4 is omitted and S1b is used to control the STARTS AFTER DELAY function.

SWEEP ROTARY SWITCH CIRCUIT BOARD

Refer to the schematic diagram. The A SWEEP TIME/DIV, B SWEEP TIME/DIV, and A VAR controls are mounted on a separate circuit board from the horizontal sweep circuits. They provide the necessary dc control signals and resistance values for steps of sweep time selection. For simplified interconnection, this board also serves as the interconnect link between the vertical preamplifier board and the A and B trigger switch boards.

Model 1590 contains one more position on both the A SWEEP TIME/DIV and B SWEEP TIME/DIV selectors than Model 1570. Model 1590 also includes switch S3 which actuates the sweep time UNCAL indicator when the A VAR control is not set to maximum, and push-pull switch S4 which selects an offset chop frequency.

TRIGGER & SWEEP CIRCUIT BOARD

Sweep Generator

This oscilloscope uses a constant current source method of generating the sweep ramp (sawtooth) waveform. This results in excellent linearity, even at high frequency. Varying the sweep time, in calibrated steps, is accomplished by changing the value of the constant charging current and the value of the sweep capacitor being charged.

Refer to the trigger & sweep board schematic diagram. A regulated voltage source of approximately +27 volts (designated VR on schematic diagram) is developed from the +55 volt input by regulator circuit IC3b and Q9. Regulated voltage VR is converted to a constant current source by IC3a and Q8. The specific charging current for a given sweep speed is determined by which of the resistors on the sweep rotary switch board are connected between VR and IC3a's input. The front panel A VAR control also varies sweep speed by controlling the constant current source via IC3a.

For the A sweep generator, capacitors C25 and TC1 are the basic sweep capacitors at high sweep speeds. At lower sweep speeds, capacitor C14, C17, or C21 (note decade increase in capacitance values) are added, depending upon which of the transistor switches Q14, Q16, or Q18 is switched on. These transistor switches are activated by inputs from the A SWEEP TIME/DIV rotary switch. Simultaneously, transistor switch Q10, Q11, or Q12 is switched on, which recalibrates regulated voltage VR for each sweep capacitor.

As the sweep capacitor charges, the voltage across its terminals increases linearly. That voltage is applied to a high impedance buffer amplifier composed of Q19 and Q20. When the output of this amplifier reaches the threshold value of comparator IC7d, it causes IC7d to change states and resets flip-flop IC2b. In turn, flip-flop IC2a is set. The output of IC2a turns on Q7, which discharges the sweep capacitors and ends the sweep.

Holdoff

Q7 is held on for a specific holdoff period to assure that the sweep capacitor is fully discharged before the next sweep is enabled. This holdoff period is dependent upon the selected sweep speed, since a larger capacitance value is being discharged at lower sweep speeds. The holdoff timing circuit is also a constant current ramp generator that operates similarly to the sweep generator.

Q22 is the constant current source for the holdoff timing circuit. The source voltage for Q22, and thus the value of constant current, is changed with each step of the A SWEEP TIME/DIV control. C24 is the holdoff capacitor at the fastest sweep rates. At slower sweep rates capacitor C13, C19, or C23 is added, depending upon activation of transistor switch Q13, Q15, or Q17. This selection is also initiated from the A SWEEP TIME/DIV rotary switch. The front panel HOLDOFF control varies the holdoff period by controlling the base voltage, and thus the constant current of Q22.

In a manner similar to the sweep generator, a ramp voltage is generated across the holdoff capacitor. Q21 and Q23 form the high impedance buffer for this circuit and IC7c is the comparator. When the ramp voltage reaches the threshold value of IC7c, it causes IC7c to change states, which sets flip-flop IC2b. In turn, this cancels the previous set condition of flip-flop IC2a and enables it to accept the next trigger pulse to start the next sweep.

Triggering

Trigger selection is made by the circuits on the A Trigger Switch board and those circuits are described elsewhere in this section.

The selected trigger signal is applied to the trigger & sweep board at connector P46. The trigger signal is applied via Schmitt trigger IC1a and IC1b to the clock input of IC2a, where it initiates the A sweep. Once triggered, the set and reset inputs to IC2a prevent it from responding to additional trigger signals at its clock input until the sweep and holdoff periods have elapsed.

Auto Trigger

The auto trigger circuit includes IC1c, Q3, Q4, and IC1d. IC1c forms a detector circuit which develops a dc voltage in the presence of trigger signals, or no voltage in the absence of trigger signals. When the trigger amplitude is sufficient so that the detected voltage exceeds the threshold of Q3, the A TRIG'D indicator is lighted. This also turns off Q4, holding its output high. The high from Q4 is combined with the sweep and holdoff gating in IC1d so that a trigger signal is required at the clock input of IC2a to start a sweep.

In the absence of trigger activity, Q3 is off and Q4 is on, holding its output low. In this condition, IC1d resets IC2a immediately at the end of the holdoff period without requiring a trigger signal.

In the NORM trigger mode, Q4 is continually held off so that no sweep occurs unless trigger signals are applied.

B Sweep

The configuration of the B sweep circuit is almost the same as the A sweep circuit just described, except that it lacks the three lowest sweep time ranges. Since the Model 1570 does not include the dual sweep mode, the B sweep holdoff circuits are omitted.

Delayed sweep (delayed triggering for B sweep) is provided by the Q24-Q26 circuit. The DELAY TIME MULTIPLIER control sets a variable threshold level to Q25. When the A sweep ramp voltage reaches that preset threshold, Q25 turns on and triggers IC8a. IC8a and IC10b form a differentiating circuit that generates a fixed width pulse which is used to reset IC5b and start the B sweep. Gate IC4d prioritizes between "starts after delay" and "triggerable after delay" modes.

Horizontal Switching

Transistors Q53 and Q54 are used to set the dc levels in the horizontal amplifier to adjust the starting positions of the A and B sweep respectively. Transistor switches Q55-Q58 gate the A sweep or B sweep to the horizontal amplifier. Whichever horizontal sweep signal has been selected is present at the input to Q60. In the X-Y mode, the horizontal signal is applied through Q59.

Horizontal Amplifier

The horizontal amplifier includes Q60-Q67 and Q70-Q71. Q64/Q65 form the x1 amplifier, while Q66/ Q67 is the x10 magnification amplifier. Selection of x10 magnification turns on Q68, which enables Q66/Q67. This action in turn disables Q69 and Q64/Q65. Q70 and Q71 convert the output impedance to 50Ω before being fed to the horizontal output amplifier board.

Blanking Control

The blanking control circuit develops the blanking signals in synchronization with the A sweep and B sweep signals. Refer to the trigger & sweep board schematic diagram and to the summary of circuit operation found in Fig. 19.

The blanking control circuits include flip-flop IC13a, its input gates IC14a and IC14e, output gates IC11a-d and IC12a, and buffers Q72-Q75.

First, flip-flop IC13a is set up according to the horizontal display mode selection control signals at P48. In the A, A-INT-B, and X-Y modes of horizontal display, IC13a is set through IC14e, which inhibits B sweep blanking in IC11c via IC12a. In the B DLY'D mode, IC13a is reset through IC14a, which inhibits A sweep blanking in IC11d. In ALT and DUAL (Model 1590 only) horizontal modes, IC13a is clocked by the A sweep gate from IC2a, which alternately inhibits IC11d and IC12d in synchronization with the A sweep.

The A sweep gate from IC2a is gated to the blanking circuits by IC11d, and the B sweep gate from IC5a is gated to the blanking circuits by IC11c. The chop signal from IC12a and b is gated by IC11a and b. Emitter followers Q72/Q72 and Q74/Q75 convert the blanking control signal to 50-ohm impedance and send it to the blanking circuits.

Two independent blanking control signals are developed at P28, one for the A sweep and one for the B sweep. In the A-INT-B and ALT horizontal modes, the blanking control signals may be simultaneous; in the blanking circuits they are superimposed to produce the intensified portion of the trace.

Vertical Pre-Clock Logic

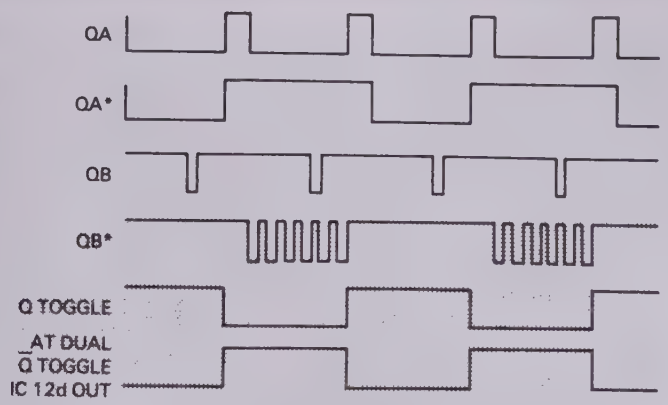
Some of the vertical channel switching control signals are generated on the trigger & sweep board. Specifically, these vertical pre-clock control signals are identified as the CP, CQ, and DS signals at P14. These control signals become inputs to the vertical control logic circuits described in Fig. 18.

The vertical pre-clock control signals are dependent upon the combination of vertical and horizontal display modes and synchronize the vertical switching with the chop and/or sweep signals. Refer to the trigger & sweep board schematic diagram. The clock pulse (CP) signal is developed by the following circuits: chop oscillator IC12a and b, flip-flop IC13b, gates IC14c and d, gates IC15a-d, and emitter follower Q77. The CQ control signal is developed by IC14f; it is high in the dual sweep mode (not applicable to Model 1570) and low in all other modes. Operation is summarized in Fig. 20.

BLANKING CONTROL

H DISPLAY	P48 X-Y BUFFER 15Pin	IC13a				IC12d	P28	
		IN		OUT			A. blanking 4 Pin	B blanking 2 Pin
		S	R	Q	$\overline{Q}$	OUT		
A	H_1	H	L	H	L	H	QA	H
ALT	H	L	L	TOGGLE		H	QA*	QB
A-INT-B	H	H	L	H	L	H	QA	QB
B-DLY'D	H	L	H	L	H	H	H	QB
DUAL	H	L	L	TOGGLE		TOGGLE	QA*	QB*
X-Y	L	H	L	H	L	H	L	H

*1 Complex waveform IC 11b and QA signals.
*2 Complex waveform IC11b output. When CHOP operation, output of P28 is complex CHOP signal waveform.



RELATIONSHIP BETWEEN A, B SWEEP AND QA, QB

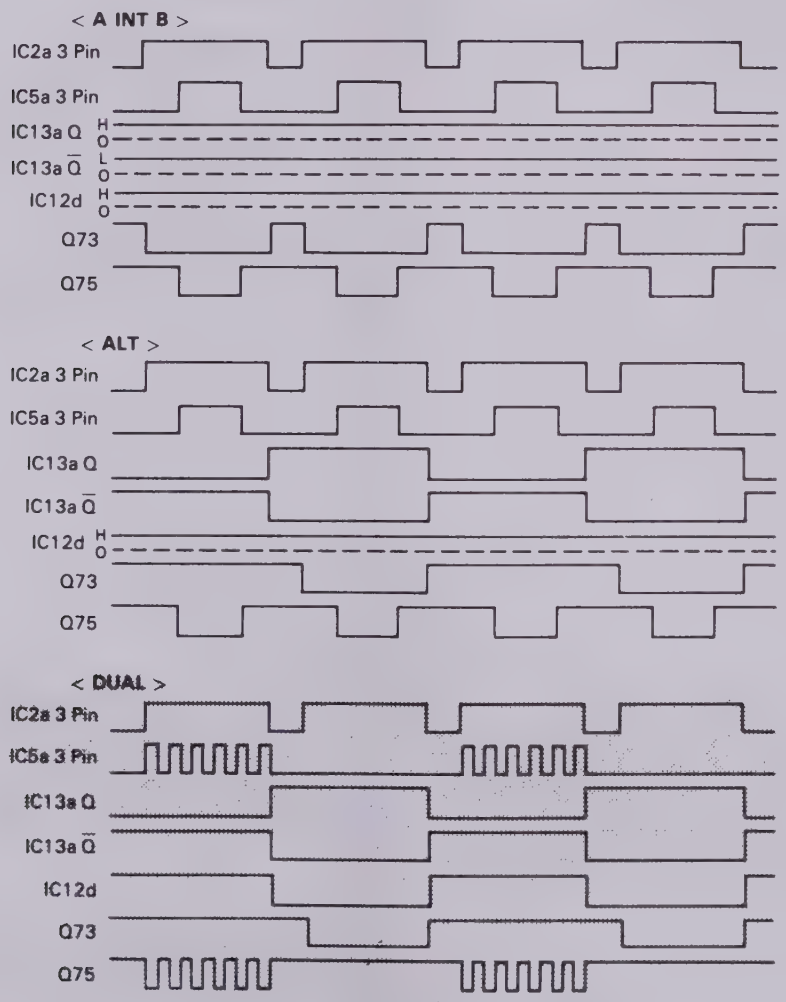


Fig. 19. Blanking Control Logic Circuit Summary.

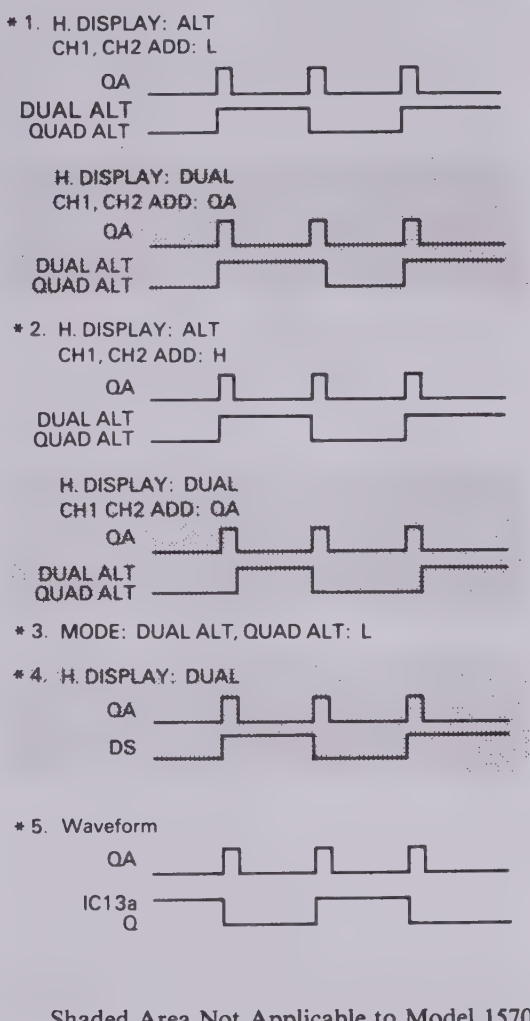
Shaded Area Not Applicable to Model 1570

V. PRE CLOCK

	MODE		INPUT ALT CHOP	INPUT Signal PRu	OUTPUT IC14d	OUTPUT IC15a,b	OUTPUT IC15c,d	OUTPUT CP	OUTPUT DS*4
SWEEP Operation	CH1		L	L	H	Refer to the right table.	QA*1	$\overline{QA}$*2	H
	CH2		L	L	H		QA*1	$\overline{QA}$*2	H
	DUAL	ALT	L	H	H		QA*1	$\overline{QA}$*2	H
		CHOP	H		L		CHOP Osc.	CHOP Pulse	H
	ADD		L	L	H		QA*1	$\overline{QA}$*2	H
	QUAD	ALT	L	H	H		QA*1	$\overline{QA}$*2	H
		CHOP	H		L		CHOP Osc.	CHOP Pulse	H
X-Y Operation			DUAL, ALT / QUAD, ALT / OTHER : L / H	H	DUAL, ALT / QUAD, ALT / OTHER : H / L		CHOP Osc *3	CHOP Pulse *3	H

Each signal of IC16a, CP, DS vary by H. DISPLAY.

H. DISPLAY	IC15b 7 Pin	IC15b 6 Pin	IC15a, b OUTPUT	CQ	IC13a Q
A	L	L	QA	L	H
ALT	H	L	L	L	*5
A-INT-B	L	L	QA	L	H
B DLY'D	L	L	QA	L	L
DUAL	H	L	QA	H	*5
X-Y	H	L	L	L	H



Shaded Area Not Applicable to Model 1570

Fig. 20. Vertical Pre-Clock Logic Circuit Summary.

In Model 1590 only, the DS control signal is developed by IC12c and Q76. This signal has no effect except in the dual sweep mode, wherein it changes state at the beginning of each A sweep pulse.

Miscellaneous

The trace separation circuit is made up of Q78-Q80 which provide a double bias voltage to the vertical amplifier in synchronization with the A and B sweep timing signals. IC8d generates a reset pulse for single sweep operation.

On Model 1590, Q27 and Q28 are buffer amplifiers that provide the A GATE and B GATE signal outputs on the rear panel.

HORIZONTAL OUTPUT AMPLIFIER BOARD

The signal from the trigger & sweep board is amplified by differential amplifier Q1-Q2. The output of this circuit is then passed to emitter follower circuit Q5-Q6 which drives final output stage Q7-Q8. Q9 and Q10 form a voltage regulation circuit which serves as the dc load for Q7 and Q8, but with ac peaking by C15 and C16. Q11 and Q12 form an auto bias circuit which automatically controls the operating point of the output stage, and also serves as the beamfinder. When the base of Q13 is grounded, the operating point of the output stage is lowered, resulting in a shrunken display.

HORIZONTAL MODE CONTROL CIRCUIT BOARD

Horizontal Display Mode Selection

The horizontal display mode selection made from the front panel pushbutton switches are latched by IC1 thru IC7, which effectively makes the non-locking switches into locking types.

Refer to the schematic diagram and to Fig. 21, the horizontal display mode selection logic circuit summary. For horizontal display, diodes D1-D9 and gates IC1d-f convert each of the six mode selection possibilities (five for Model 1570) into a 3-bit code, which is applied to the "D" inputs of IC4. Waveform shaping is used in the IC1 circuit for switch debounce; that is, momentary closure of a front panel switch is stretched into a fixed width pulse.

Diodes D10-D12 and gates IC2c, d, e and IC3d form a circuit that clocks latch register IC4 regardless of which switch of the horizontal group has been pressed. However, this clock signal is delayed in comparison with the "D" inputs of IC4. When latch register IC4 is clocked, the 3-bit coded input is latched in the 3-bit coded output. This mode selection is held until another horizontal mode select button is pressed, or the same mode button is pressed again.

IC5d, e, and f are buffers that apply the 3-bit code to IC6. IC6 decodes the 3-bit input to a 1-of-6 output. The output of IC6 drives the indicator LED in the face of the mode select pushbutton as a readout of the selected mode. The output of IC6 also drives the mode select gates, which in turn control blanking and sweep switching.

H. DISPLAY PUSH	Qt				Qt + 1									
	IC1 OUTPUT			IC4 9 PIN	IC5 1 pin / 15 pin	IC4 2 pin / IC5 13 pin	IC4 5 pin / IC5 11 pin	IC4 7 pin / IC5 9 pin	IC6 OUTPUT					
	12 Pin	10 Pin	8 Pin						2	3	4	5	6	7
A	L	L	∫	∫	L	L	L	H	L	H	H	H	H	H
ALT	L	∫	L	∫	L	L	H	L	H	L	H	H	H	H
A-INT-B	L	∫	∫	∫	L	L	H	H	H	H	L	H	H	H
B	∫	L	L	∫	L	H	L	L	H	H	H	L	H	H
DUAL	∫	L	∫	∫	L	H	L	H	H	H	H	H	L	H
X-Y	∫	∫	L	∫	L	H	H	L	H	H	H	H	H	L

Qt = Logic level when switch is pressed.
Qt + 1 = Logic level after switch is pressed (selection latched).

Fig. 21. Horizontal Display Mode Selection Logic Circuit Summary.

Trigger Mode Selection

Operation of the trigger mode logic circuits is functionally the same as the horizontal display mode selection circuits just described. Refer to the horizontal mode control board schematic diagram and Fig. 22, the trigger mode selection logic circuit summary. Diodes D13-D16 and gates IC1a and b are used to encode 2 bits of switch status information for this switch group. D17, D18, IC2a, b, f, and IC3a clock the 2-bit code into latch register IC7a and b. IC8b, c, and d form a 2-bit to 1-of-3 decoder. IC5a, b, c and IC9a-f are buffers that drive triggering mode switching gates. Transistors Q1, Q2, and Q2 are LED drivers for the front panel indicators.

Mode Selection Memory

Mode selection circuits are powered by $+V_M$ (+ memory voltage), which is powered when the scope is turned off. For Model 1590, a Lithium battery is used, and for Model 1570 storage capacitor C100 will power the memory circuits for at least two days. Control is performed by Q4, D19, D20, IC3b and c, and IC8a. D19 and D20 isolate $+V_M$ from the source voltage. When ac powered, +5 volts is available through D20. With ac power off, the circuit continues to operate from the lithium battery (Model 1590) or the charge on C100 (Model 1570), through D19. Q4 and IC3b and c detect the power off condition and generate a memory save signal (CONT), while IC8a is an inverter that provides the CONT memory save signal. The CONT and CONT signals initiate memory save in the vertical, horizontal, and triggering mode logic circuits.

Calibration Square Wave Circuit

Q11 and Q12 form a multivibrator which generates a 1 kHz square wave. The frequency is calibrated by adjustment of VR2. Q10 provides impedance matching for the calibration output. A voltage calibration terminal is located on the front panel. R70 and R71 establish calibration amplitude, trimmed to the correct level by VR1. IC17 is a voltage regulator used only by the calibration square wave circuits.

On Model 1590 only, the output of Q10 is also applied to a current calibration loop on the rear of the oscilloscope. This provides a 10 mA, 1 kHz square wave for adjusting a current probe.

TRIG MODE

TRIG MODE PUSH	Qt			Qt + 1											
	IC1		IC3	IC7				IC8-4	IC8-11	IC8-10	IC9				
	4 Pin	2 Pin	3 Pin	13 Pin	12 Pin	1 Pin	2 Pin	IC5-3	IC5-5	IC5-7	8 Pin	10 Pin	12 Pin	4 Pin	2 Pin
AUTO	∫	L	∫	H	L	L	H	L	H	H	H	L	L	H	H
NORM	L	∫	⌐	L	H	H	L	H	L	H	L	H	L	L	H
SINGLE	∫	∫	⌐	H	L	H	L	H	H	L	L	L	H	H	L

Qt = Logic level when switch is pressed.
Qt + 1 = Logic level after switch is pressed (selection latched).

RESET (TRIG MODE "SINGLE")

RESET PUSH (TRIG MODE SINGLE)	Qt	Qt + 1	
	P48 10Pin	IC2b 3 Pin	IC3a 3 Pin
	⌐	L	L

Fig. 22. Trigger Mode Selection Logic Circuit Summary.

CH3 and CH4 Input Circuits

The inputs to channels 3 and 4 are routed from the front panel to the horizontal mode control board. There, FET Q13 (for channel 3) provides the 1 megohm input impedance. Emitter followers Q14/Q15 provide buffering and a low output impedance for coupling the signal to the vertical preamplifier board. The configuration of the channel 4 circuit is similar to the channel 3 circuit just described.

For Model 1590, the channel 3 and 4 inputs offer a choice of 1/1 or 1/10 attenuation. Whenever the 1/10 attenuation is selected, Q16 (channel 3) or Q20 (channel 4) drives a relay to switch the attenuation between 1:1 and 10:1.

SWITCHING POWER SUPPLY

The Model 1570 and 1590 Oscilloscopes make use of a switching regulator type power supply. Input of roughly 100 or 200 volts is rectified and filtered to an approximate 200 volts dc. Next, a power transistor chops the dc to drive a compact converter transformer. The transformer has six bifilar windings which provide six separate outputs which are rectified and filtered for operation of the instrument. One of the outputs is compared with a reference voltage to form an error voltage for regulation. The error voltage is sent to an error amplifier, the output of which is used to control the base of the power transistor. This output is isolated from the primary by a photocoupler.

POWER SUPPLY & BLANKING CIRCUIT BOARD

Regulators

Five of the outputs of the switching power supply are further regulated using a series regulation method on the power supply & blanking circuit board. Refer to the schematic diagram. This is accomplished by Q1, Q2, and IC1a (+120 volt regulator), Q3, Q4, and IC2a and b (+10 and -10 volt regulators), Q5 and IC1b (+5 volt regulator), and Q6 and Q7 (+20 volt regulator).

High Voltage Regulator

A conventional high voltage dc-dc converter is used (the high voltage portion of the circuit is located off this board in the separate high voltage block, see "High Voltage Power Supply" paragraph). Q25-Q27 are error voltage amplifiers for the high voltage dc-dc converter, while Q29 acts as the control transistor.

Unblanking

Independent intensity control for A and B sweep is implemented by Q13-Q15. An unblanking pulse, coincident with the A sweep and B sweep respectively, is applied through Q13 and Q14 and combined in Q15. In Model 1590 only, Q16 unblanks the beam when the beamfinder input is applied, even if the intensity controls are set to minimum. Q17 superimposes the Z AXIS input on the blanking signal for intensity modulation, with intensity increasing for a positive polarity input. The various blanking inputs are combined at the base of Q18, which, in turn, drives Q19. Q20 forms the dc load for Q19, with C25 giving ac peaking. A switching voltage from the converter transformer is applied through Q23 and C36 to diode rectifier D10-D11. This rectifier circuit is referenced at the -1.7 kV cathode voltage. D10 and D11 develop an additional dc voltage at the CRT intensity grid to blank the electron beam. The blanking signal (actually the unblanking signal) from Q19 clamps the amplitude of the Q23 output to a lower level via D8, resulting in less output from rectifier D10-D11 and the electron beam is unblanked. C37 couples the unblanking signal for fast response.

Auto-Focus

Q21 and Q22 form the auto-focus circuit which applies a signal to the focus electrode of opposite polarity from the unblanking signal. This improves focus over a wide range of intensity settings. Operation is nearly the same as just described for the unblanking circuit. The unblanking signal from Q19 is also applied to Q21-Q22 which function similarly to Q19-Q20 except the signal is inverted. Q23 is emitter coupled to Q24 so that the switching voltage from the converter transformer is also applied to rectifier D12-D13. The inverted unblanking signal from Q21 affects the D12-D13 rectifier in the opposite manner of the D10-D11 circuit. The output of the D12-D13 rectifier circuit is applied to the focus grid, so that that the focus grid voltage tracks the intensity grid voltage and maintains beam focus.

Miscellaneous

Q8 controls scale illumination (PL1 - PL4), while Q9-Q10 controls trace rotation. On Model 1590 only, Q11 and Q12 form the Y axis (perpendicularity) adjustment circuit.

HIGH VOLTAGE POWER SUPPLY

For high voltage safety, and to prevent leakage, the high voltage power supply is encapsulated in resin. Within this encapsulated block is the dc-to-dc converter, -1.7 kV cathode voltage supply, floating 6.3 volt filament supply, and the 14 kV (Model 1590) or 10 kV (Model 1570) anode cap voltage supply. The -1.7 kV cathode voltage supply is brought back into the power supply & blanking circuit board for use in the blanking and focus circuits.

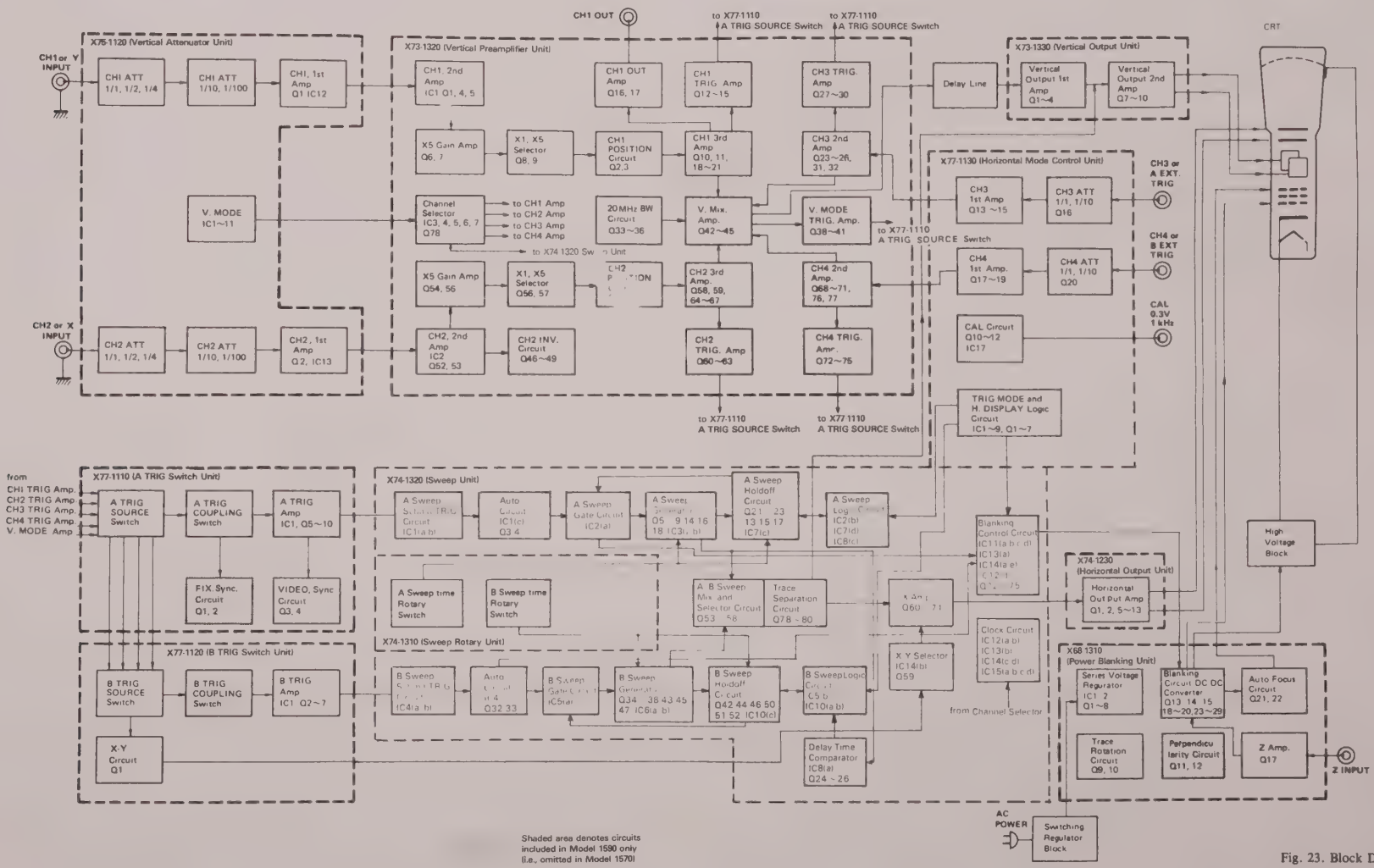

CH1 OUT
to X77-1110 A TRIG SOURCE Switch
to X77-1110 A TRIG SOURCE Switch
CRT
X75-1120 (Vertical Attenuator Unit)
CH1 or Y INPUT
CH1 ATT 1/1, 1/2, 1/4
CH1 ATT 1/10, 1/100
CH1, 1st Amp Q1 IC12
V. MODE IC1~11
CH2 or X INPUT
CH2 ATT 1/1, 1/2, 1/4
CH2 ATT 1/10, 1/100
CH2, 1st Amp Q2, IC13
X73-1320 (Vertical Preamplifier Unit)
CH1, 2nd Amp IC1 Q1, 4, 5
X5 Gain Amp Q6, 7
X1, X5 Selector Q8, 9
Channel Selector IC3, 4, 5, 6, 7 Q78
to CH1 Amp
to CH2 Amp
to CH3 Amp
to CH4 Amp
to X74-1320 Sweep Unit
CH2, 2nd Amp IC2 Q52, 53
X5 Gain Amp Q54, 56
X1, X5 Selector Q56, 57
CH2 INV. Circuit Q46~49
CH1 OUT Amp Q16, 17
20MHz BW Circuit Q33~36
CH1 POSITION Circuit Q2,3
CH1 TRIG. Amp Q12~15
CH1 3rd Amp Q10, 11, 18~21
V. Mix. Amp. Q42~45
CH2 3rd Amp. Q58, 59, 64~67
CH2 TRIG. Amp Q60~63
CH3 TRIG. Amp Q27~30
CH3 2nd Amp Q23~26, 31, 32
V. MODE TRIG. Amp. Q38~41
CH4 2nd Amp. Q68~71, 76, 77
CH4 TRIG. Amp. Q72~75
to X77-1110 A TRIG SOURCE Switch
to X77-1110 A TRIG SOURCE Switch
Delay Line
X73-1330 (Vertical Output Unit)
Vertical Output 1st Amp Q1~4
Vertical Output 2nd Amp Q7~10
X77-1130 (Horizontal Mode Control Unit)
CH3 1st Amp Q13 ~15
CH3 ATT 1/1, 1/10 Q16
CH4 1st Amp. Q17~19
CH4 ATT 1/1, 1/10 Q20
CAL Circuit Q10~12 IC17
CH3 or A EXT. TRIG
CH4 or B EXT TRIG
CAL 0.3V 1 kHz
to X77-1110 A TRIG SOURCE Switch
TRIG MODE and H. DISPLAY Logic Circuit IC1~9, Q1~7
to X77-1110 A TRIG SOURCE Switch
to X77-1110 A TRIG SOURCE Switch
from CH1 TRIG Amp
CH2 TRIG Amp
CH3 TRIG Amp
CH4 TRIG Amp
V. MODE Amp
X77-1110 (A TRIG Switch Unit)
A TRIG SOURCE Switch
A TRIG COUPLING Switch
A TRIG Amp IC1, Q5~10
FIX. Sync. Circuit Q1, 2
VIDEO, Sync Circuit Q3, 4
X77-1120 (B TRIG Switch Unit)
B TRIG SOURCE Switch
B TRIG COUPLING Switch
B TRIG Amp IC1 Q2~7
X-Y Circuit Q1
X74-1320 (Sweep Unit)
A Sweep Holdoff Circuit Q21 23 13 15 17 IC7(c)
A Sweep Gate Circuit IC2(a)
Auto Circuit IC1(c) Q3 4
A Sweep Logic IC2(b) IC7(d) IC8(c)
Blanking Control Circuit IC11(a b c d) IC13(a) IC14(a e)
A Sweep time Rotary Switch
B Sweep time Rotary Switch
A B Sweep Mix and Selector Circuit Q53 58
Trace Separation Circuit Q78 ~ 80
X74-1310 (Sweep Rotary Unit)
B Sweep Holdoff Circuit Q42 44 46 50 51 52 IC10(c)
B Sweep Gate Circuit IC5(a)
B Sweep Logic IC5 b IC10(a b)
Delay Time Comparator IC8(a) Q24 ~ 26
X Y Selector IC14(b) Q59
Clock Circuit IC12(a b) IC13(b) IC14(c d) IC15(a b c d)
from Channel Selector
X74-1230 (Horizontal Output Unit)
Horizontal Out Put Amp Q1, 2, 5~13
High Voltage Block
X68-1310 (Power Blanking Unit)
Series Voltage Regurator IC1 2 Q1~8
Blanking Circuit DC DC Converter Q13 14 15 18~20, 23~29
Auto Focus Circuit Q21, 22
Trace Rotation Circuit Q9, 10
Perpendicularity Circuit Q11, 12
Z Amp. Q17
Z INPUT
AC POWER
Switching Regulator Block
Shaded area denotes circuits included in Model 1590 only (i.e., omitted in Model 1570)

Fig. 23. Block Diagram.

DISASSEMBLY

Unless otherwise stated, all information in this section applies equally to Model 1570 and 1590.

WARNING

High voltage up to 16 kV (Model 1590) or 12 kV (Model 1570) is present when the oscilloscope is operating. Observe all high voltage precautions when the unit is operated with the case removed. Remember that a high voltage charge may be retained indefinitely, especially at the CRT socket and anode cap. Discharge high voltage capacitors after removing power. Also remember that ac line voltage may be present at a few points any time the power cord is connected to an ac outlet, even if the unit is turned off.

GENERAL

Be sure to observe all notes and cautions when disassembling this unit.

Care must be exercised when connecting or disconnecting cables to prevent broken wires or bent pins.

The wiring scheme of the oscilloscope has been designed for convenience in servicing, as follows:

1. The wire color code for pins 1 and 2 of all plugs represents the plug number.

   For example:

   P20 Pin 1 is Red (first digit 2)
   Pin 2 is Black (second digit 0)

   P04 Pin 1 is Black (first digit 0)
   Pin 2 is Yellow (second digit 4)

2. Each cable is assigned the same plug number at both ends (if a cable has plug P36 on one end, the plug on the other end is also designated P36). These numbers are stamped onto each connector and are screened onto the printed circuit board adjacent to the mating receptacle to simplify cable reconnection.

REMOVAL OF CASE

(Refer to Fig. 24)

1. Remove the CH3 and CH4 POSITION knobs and washers.

2. Remove four screws "A" located on the rear of the case, and one screw "B" located on the bottom of the case. Carefully slide the chassis forward from the case.

   CAUTION

   When sliding the chassis into the case, be sure no wires get caught on the handle washer inside the case. Also be sure rf gasket is not damaged.

3. To install the chassis in the case, lay the case down and slide in the chassis using the rails located at the bottom of the case. Then, stand the chassis up and engage the case front edge into the front panel groove.

4. Temporarily insert the case retaining screws, then tighten them evenly.

5. Install the CH 3 and CH 4 POSITION knobs.

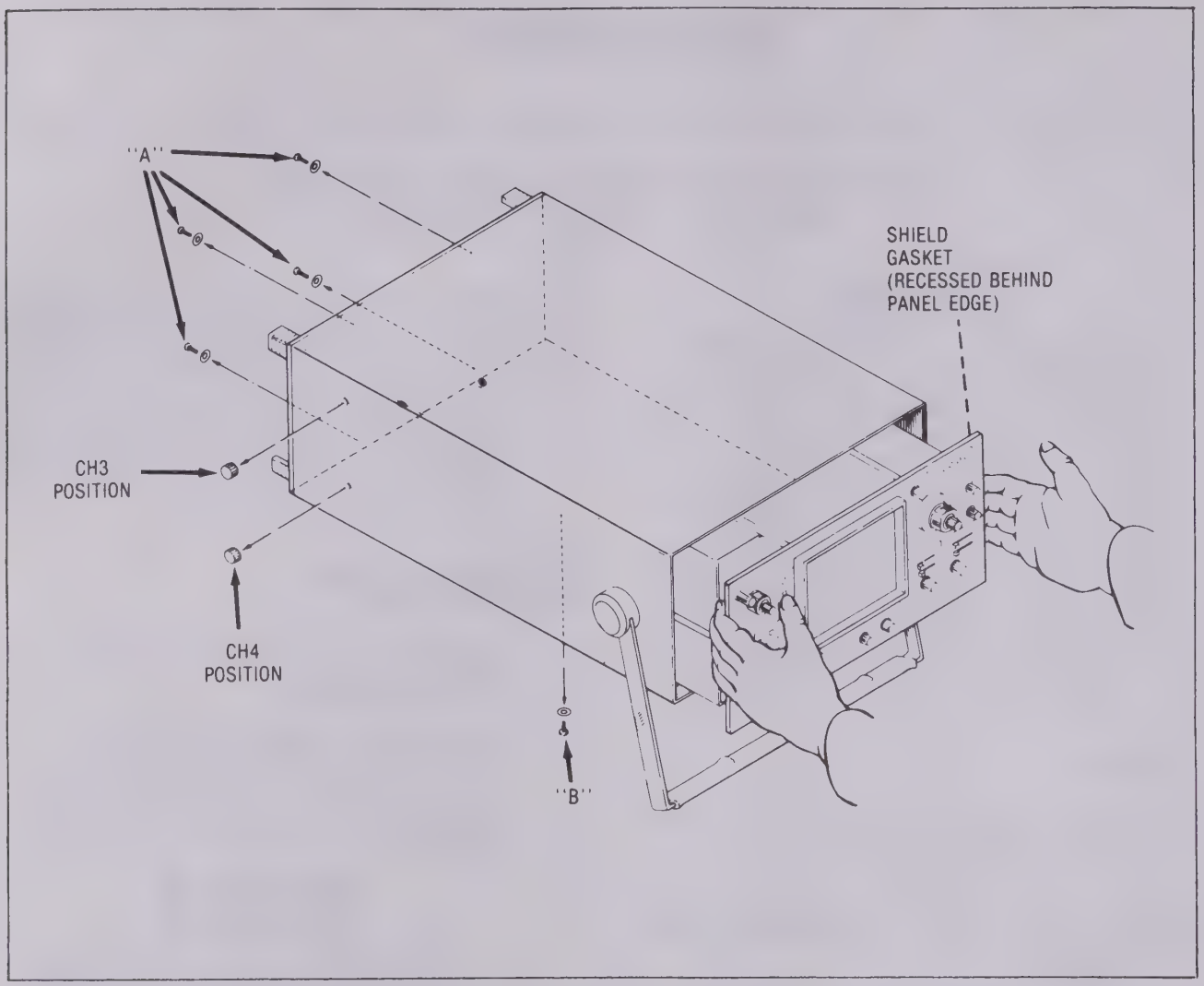


Fig. 24. Case Removal.

CRT REMOVAL/INSTALLATION

(Refer to Fig. 25)

WARNING

High voltage is present at the anode of the CRT, which may be retained indefinitely after the oscilloscope is turned off. Before removing the CRT, connect the anode to ground via a 100 kΩ load for 5 seconds to discharge the voltage.

1. Disconnect the anode cap on the bottom of the CRT.
2. Remove two screws "A" securing the CRT shield.
3. Observe and record the connections of the deflection plate wires connected near the center of the CRT.
4. Disconnect the +X and -X (horizontal) deflection plate wires at the CRT from the horizontal output amplifier board.
5. Disconnect the CRT shield grounding wire attached to the corner standoff for the horizontal output amplifier board.

6. Remove two screws "B" securing the CRT to the angle support near the rear of the chassis.

7. Lift up about 4 inches on the rear of the CRT assembly and disconnect the CRT socket.

8. Disconnect the +Y and -Y (vertical) deflection plate wires at the CRT from the vertical output amplifier board. On Model 1590, also disconnect the ISD wire at the CRT (also from the vertical output amplifier board).

9. Remove entire CRT assembly (with shields still attached) from chassis.

10. To remove CRT from shield assembly, loosen two screws "C" and slide the CRT out of the rear shield assembly.

11. Scale illumination lamps are located in the mounting rubber around the CRT front plate. When installing CRT, move lamps within mounting rubber for brightest scale illumination.

PRINTED CIRCUIT BOARD REMOVAL

Care must be observed when removing printed wiring boards to prevent wire breakage and connector damage.

Trigger & Sweep Board (X74-1320)

1. The trigger & sweep board is the large outer board located on the right side of the oscilloscope (Fig. 26).

2. The trigger & sweep board is hinged for easy access. Most testing and troubleshooting is possible without complete removal of the board. Unclip the plastic support bracket from the edge of the board, remove two screws "A" (Fig. 26), and fold out top of trigger & sweep board.

3. For complete removal of the board, disconnect all cable connectors including the ribbon cable to the horizontal mode control board.

4. The trigger & sweep board can now be removed by removing hinge pins.

Horizontal Mode Control Board (X77-1130)

The horizontal mode control board is the large board located directly under the trigger & sweep board on the right side of the oscilloscope (Fig 26).

Access to horizontal mode control board for testing can be accomplished by rotating the hinged trigger & sweep board out of the way.

1. To remove horizontal mode control board, set chassis on left side and remove the trigger & sweep board.

2. Disconnect all ribbon cables, cable connectors, and coaxial cables from the horizontal mode control board.

3. Remove four corner screws holding horizontal mode control board to inner channel of frame.

4. Carefully lift board out of chassis.

Horizontal Output Amplifier Board (X74-1230)

The horizontal output amplifier board is located next to the CRT on the right side of the oscilloscope (Fig 26).

1. Disconnect the +X and -X (horizontal) deflection plate wires from the CRT.

2. Disconnect all cable connectors from the board.

3. Remove two screws and washers attaching board to inner channel of frame.

4. When reinstalling, be sure to reattach CRT shield grounding wire under the rear mounting screw of the board.

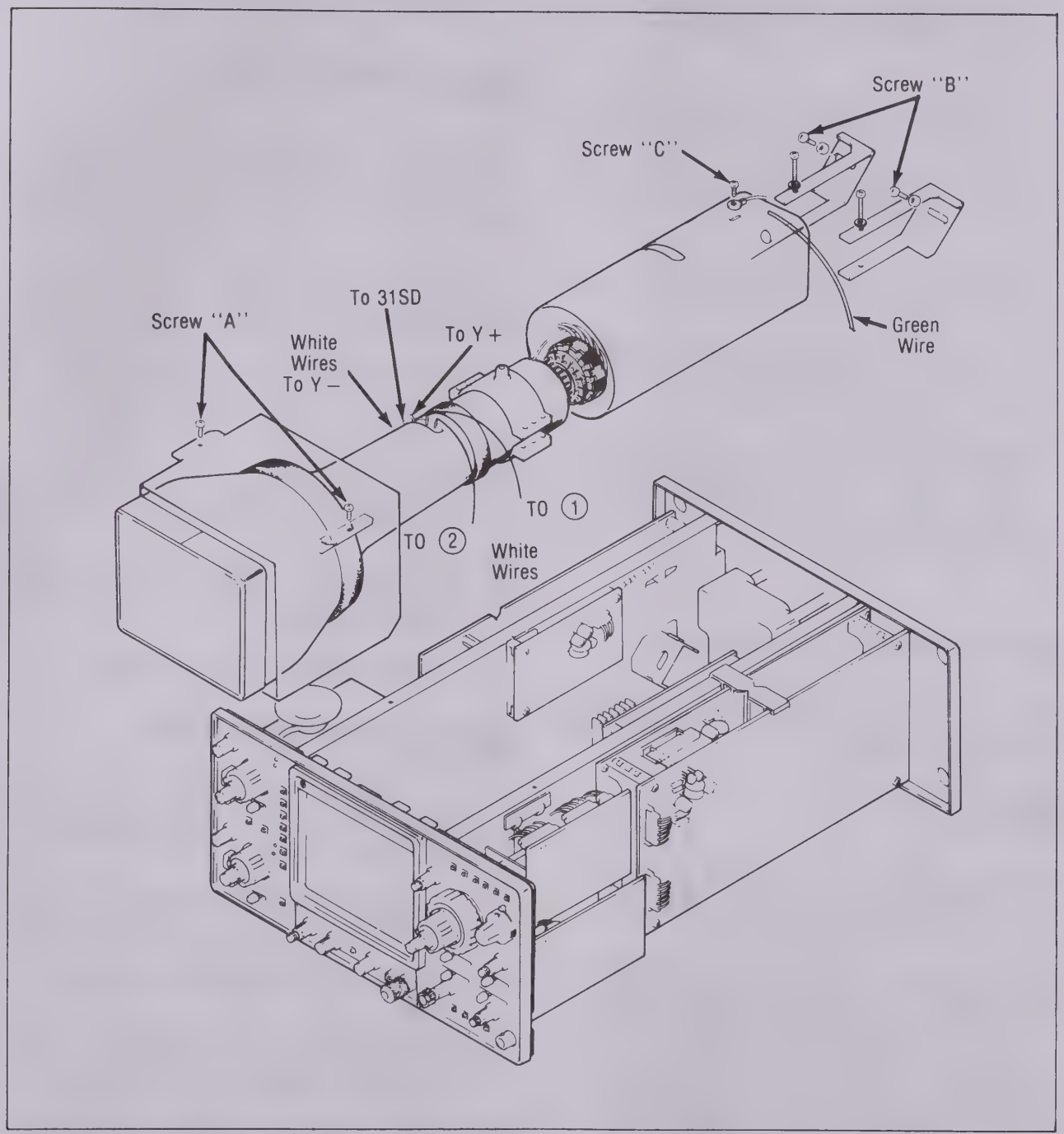


Fig. 25. CRT Removal.

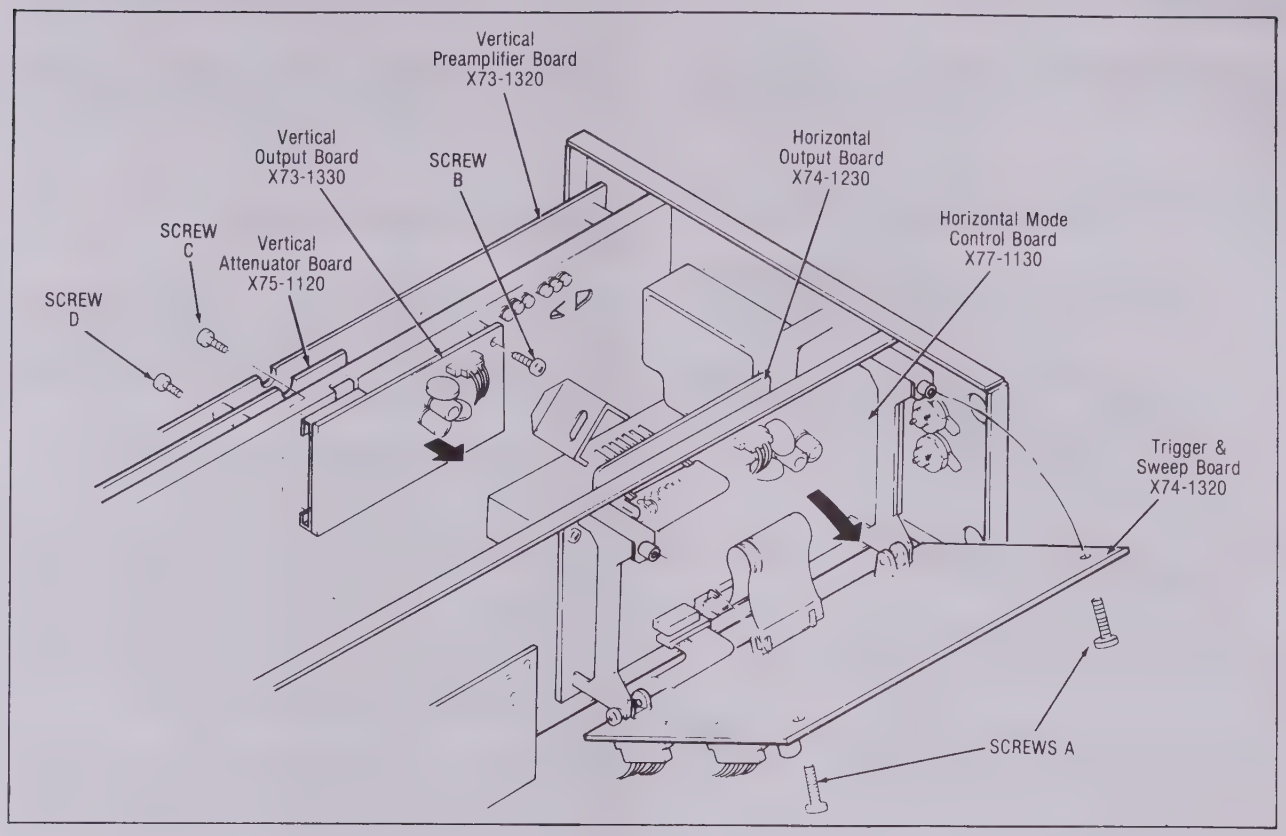


Fig. 26. Location of PCBs.

Vertical Output Amplifier Board (X73-1330)

The vertical output amplifier board is located on the left center channel of the frame, adjacent to the CRT (Fig. 26).

1. Disconnect the +Y and -Y (vertical) deflection plate wires going to the CRT from points 4 and 5 of the vertical output amplifier board. For Model 1590, also disconnect the ISD wire going to the CRT from point 3 of the board.

2. Remove screws "B", "C", and "D" (Fig. 26). Screw "D" is accessible through a hole in the vertical preamplifer board.

3. Disconnect P20 and P29, then move board out sufficiently to disconnect P10 and P3.

4. Lift board out.

Vertical Preamplifier Board (X73-1320)

The vertical preamplifier board is the large outer board on the left side of the oscilloscope (Fig. 26).

1. Disconnect all cable connectors from the vertical preamplifier board.

2. Remove the four screws and washers securing the corners of the board.

3. Carefully disengage P4 from vertical attenuator board X75-1120 (located underneath) and lift off the vertical preamplifier board.

Power Supply & Blanking Board (X68-1310)

The power supply & blanking board is located on the bottom of the oscilloscope between the inner channels of the frame (Fig. 27).

1. Pull forward on the FOCUS and SCALE ILLUM knobs to disengage from shaft.
2. Remove two screws and washers "A" attaching bracket to center supports.
3. Remove plastic insulator which covers the board. This assembly is also hinged and can now be rotated upward for servicing when complete removal is not required.
4. For complete removal, remove two screws "B" (Fig. 27).
5. Lift board up only as far as necessary to disconnect the cable connectors.
6. Note and record arrangement of wires connected to the POWER ON-OFF switch; unsolder the four wires.
7. Remove board.
8. When reattaching the FOCUS and SCALE ILLUM-POWER controls, first push knob onto shaft and rotate control to full counterclockwise position. Knob index line for POWER control should be at OFF. If not, disengage knob and reposition to OFF. Knob index for FOCUS control should be at about a 7 o'clock position.

Switching Power Supply

The switching power supply is located in the shielded case at the bottom rear of the oscilloscope (Fig. 27).

1. Remove the vertical preamplifier board to gain access to mounting screws.
2. Remove trigger & sweep board (Fig. 26) and horizontal mode control board to gain access to switching power supply mounting screws.
3. Remove the four mounting screws (two each side).
4. Lift switching power supply up sufficiently to disconnect the two cables, then remove unit.

Vertical Attenuator Assembly (X75-1120)

The vertical attenuator is located on the left side, partially sandwiched between the vertical preamplifier board and the left frame channel (Fig. 26 and 28).

1. Remove the vertical preamplifier board.
2. Remove the VOLTS/DIV and concentric VARIABLE knobs for both channels 1 and 2. Be careful not to lose the small springs located between the VARIABLE knobs and the VOLT/DIV knobs whenever the VARIABLE knobs are removed. Remove hex nuts holding switches.
3. Remove the two standoffs used to separate the vertical attenuator board from the previously removed vertical preamplifier board.
4. Disconnect the two cable connectors at rear of board.
5. For Model 1590, remove the screws connecting braided shield between switch enclosures and PUSH 50Ω switches.
6. Unsolder the shield straps (braided and copper) connected between the front panel and the CH 2 switch enclosures.
7. Disconnect braided shield from CH 1 switch enclosure to center channel of frame.
8. Unsolder capacitor grounded at the CH 1 switch enclosure.
9. Remove switch enclosure covers.
10. Unsolder resistor at switch inputs.

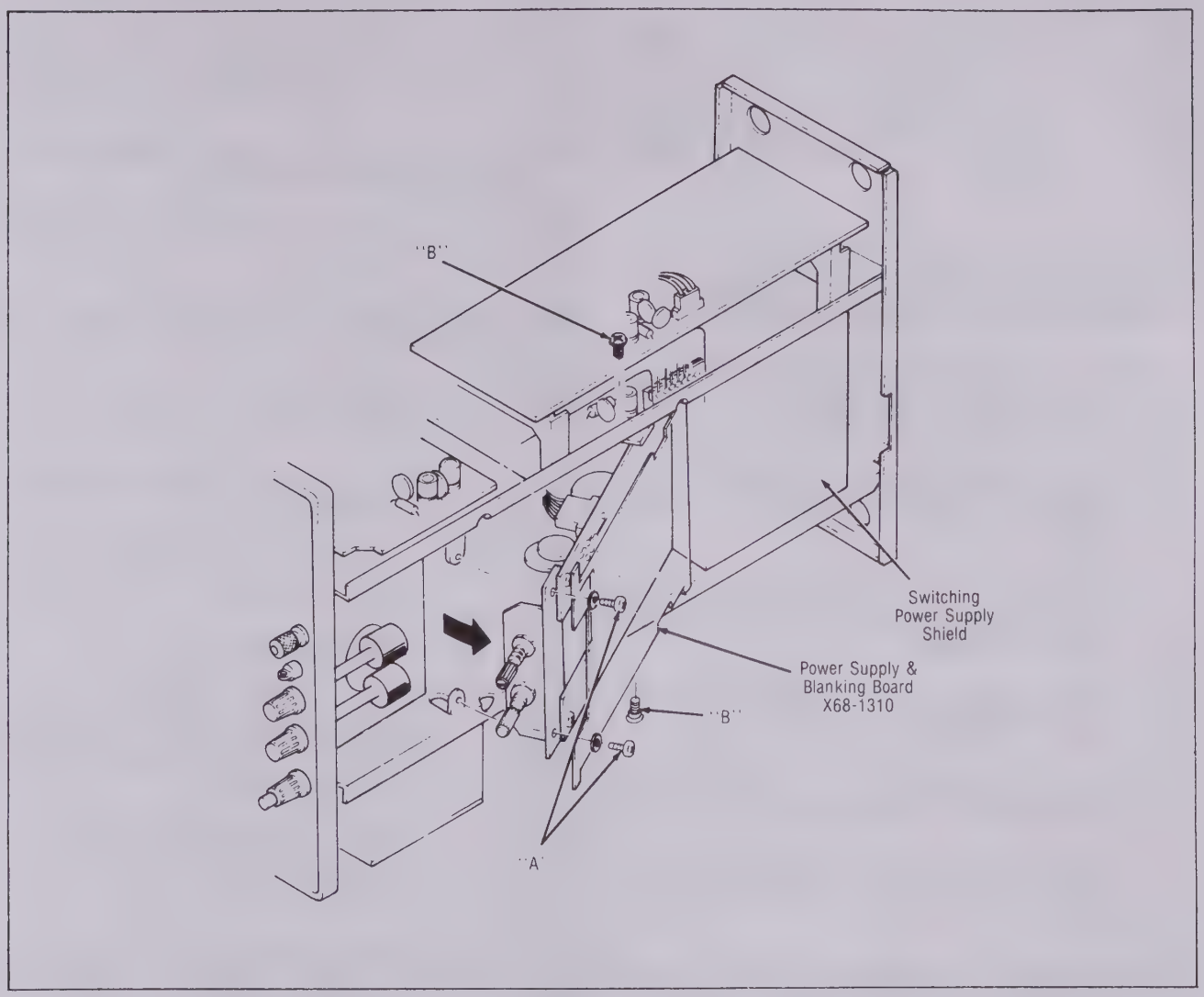


Fig. 27. Power Supply & Blanking Board Removal.

11. Lift board up slightly, then disconnect ribbon cable from underside of board.

12. Slide board assembly toward rear of scope, so control shafts clear front panel.

13. When reassembling, observe the following:

    a. Position board with switches protruding through front panel.

    b. Carefully reach under board and press ribbon cable connector into place, taking care not to bend connector pins.

    c. Be sure to reconnect resistors to switch terminals and capacitor to switch enclosure.

    d. Be sure all ground straps are reconnected.

    e. Mount VOLTS/DIV switches with hex nuts, attach knobs, then rotate fully clockwise. Check that knob index line points to 5 mV. Loosen knob and reposition if necessary.

f. Install spring on shaft, then attach VARIABLE knobs. Rotate fully clockwise to CAL position. Check that index line on knob is aligned with CAL. Reposition if necessary.

A Trigger Switch Board (X77-1110), B Trigger Switch Board (X77-1120), and Sweep Rotary Switch Board (X74-1310)

These boards are located at the right front of the oscilloscope and should be removed from the chassis as a unit (Fig. 28).

1. Set all lever switches for A and B trigger controls to center position and remove knobs.

2. Remove A and B SLOPE and LEVEL control knobs and serrated nut attaching switches to panel.

3. Remove FINE and POSITION control knobs and serrated nut.

4. Remove HOLDOFF and TRACE SEP control knobs and serrated nut.

5. Rotate DELAY TIME MULTIPLIER control fully counterclockwise and remove knob.

6. Set SWEEP TIME/DIV A and B control knobs fully clockwise (.02 μsec position for Model 1590, .05 μs position for Model 1570) and A VAR control to CAL position; remove knob and hex nut.

7. Lift off front panel.

8. Disconnect the following cables:

   A trigger switch board:

   P51 and P47.

   B trigger switch board:

   P43, P51, and P55.

   Sweep rotary switch board:

   P40, P41, and P42.

9. Disconnect ground strap at rear of board attached to the horizontal mode control board mounting screw.

10. Remove four front panel screws located between the lever switches.

11. Lift complete assembly out of oscilloscope.

12. Further disassembly is obvious upon inspection.

13. When reassembling, be sure to do the following.

    a. Attach unit to front panel with four screws.

    b. Be sure to reconnect ground strap at rear of board.

    c. Mount front panel.

    d. Install LEVEL control knobs so that knobs rotate clockwise between about 7 o'clock and 5 o'clock positions.

    e. Install SLOPE switch knobs so that index line switches between (-) and (+) position.

    f. Install POSITION and FINE knobs so that maximum clockwise position is at about 5 o'clock.

    g. Install TRACE SEP knob so that maximum clockwise position is at about 5 o'clock.

    h. Position HOLDOFF knob so that switch index points to NORM at maximum clockwise position.

    i. Position the DELAY TIME MULTIPLIER control at maximum counterclockwise and set knob so outer scale reads "0" and inner scale reads "20"; then attach knob.

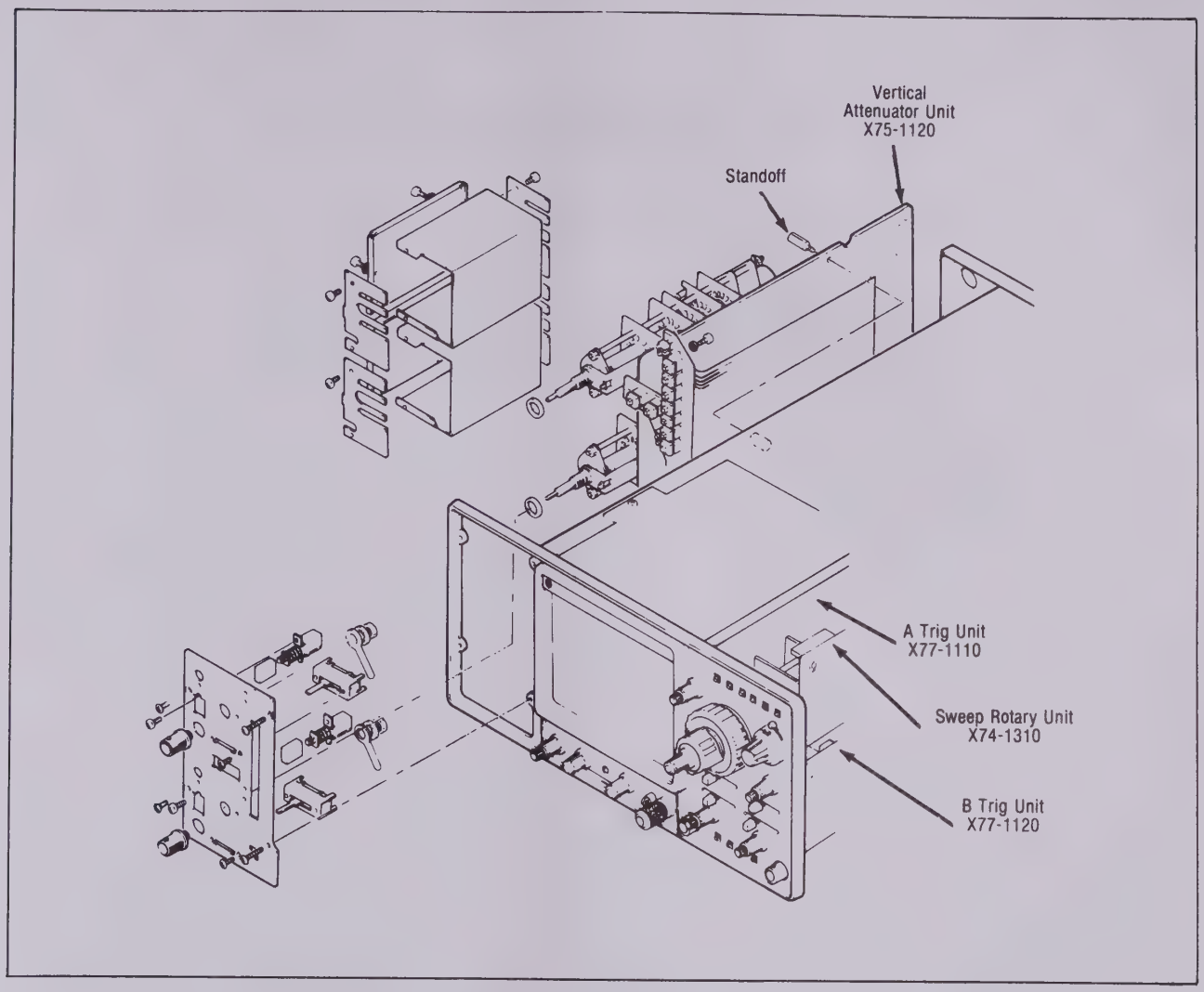


Fig. 28. Vertical Attenuator & Preamp.

j. Mount A SWEEP TIME/DIV knob and rotate fully counterclockwise. If index line on knob is not pointing to .5 SEC, loosen knob and reposition.

k. Rotate B SWEEP TIME/DIV control to maximum counterclockwise. Set knob index line at 50 ms and attach knob. Check that knob rotates clockwise and stops at .02 μs position for Model 1590 or .05 μs position for Model 1570.

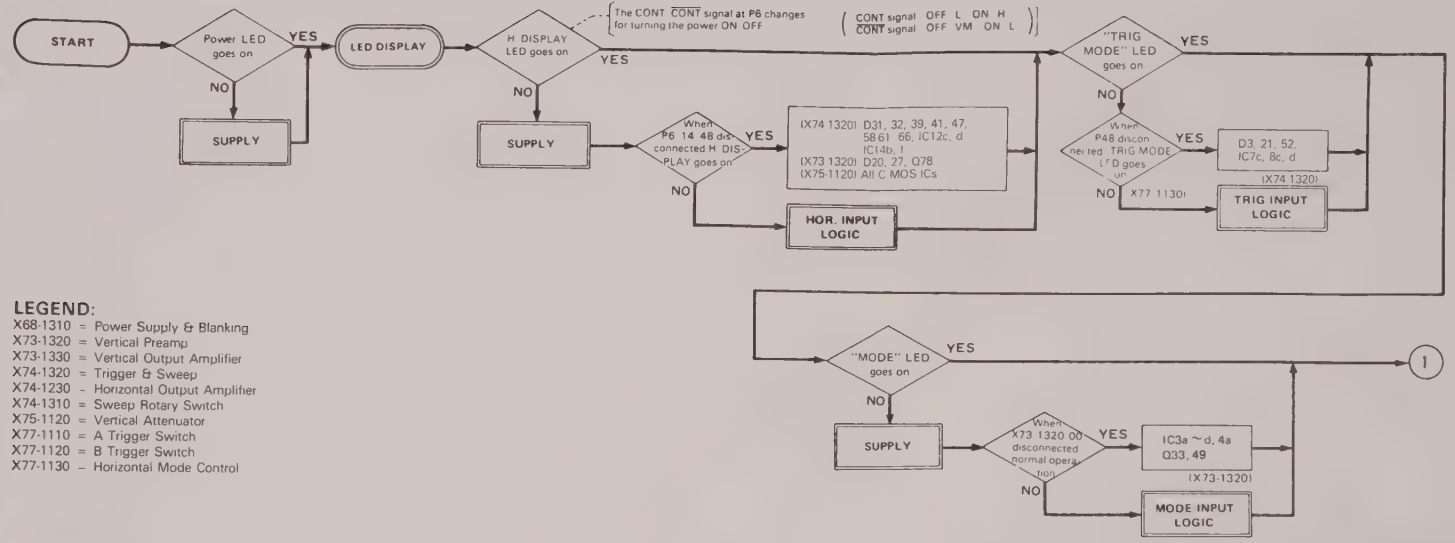
l. Rotate A VAR control to full clockwise position (CAL) and mount knob so that index line is at about 5 o'clock position.

m. Recheck mechanical operation of all control to insure free operation.

TROUBLESHOOTING

Unless otherwise stated, all information in this section applies equally to Model 1570 and 1590. Shaded areas highlight differences between models.

TROUBLESHOOTING



LEGEND:

X68-1310 = Power Supply & Blanking
X73-1320 = Vertical Preamp
X73-1330 = Vertical Output Amplifier
X74-1320 = Trigger & Sweep
X74-1230 = Horizontal Output Amplifier
X74-1310 = Sweep Rotary Switch
X75-1120 = Vertical Attenuator
X77-1110 = A Trigger Switch
X77-1120 = B Trigger Switch
X77-1130 = Horizontal Mode Control

Shaded Area Not Applicable to Model 1570

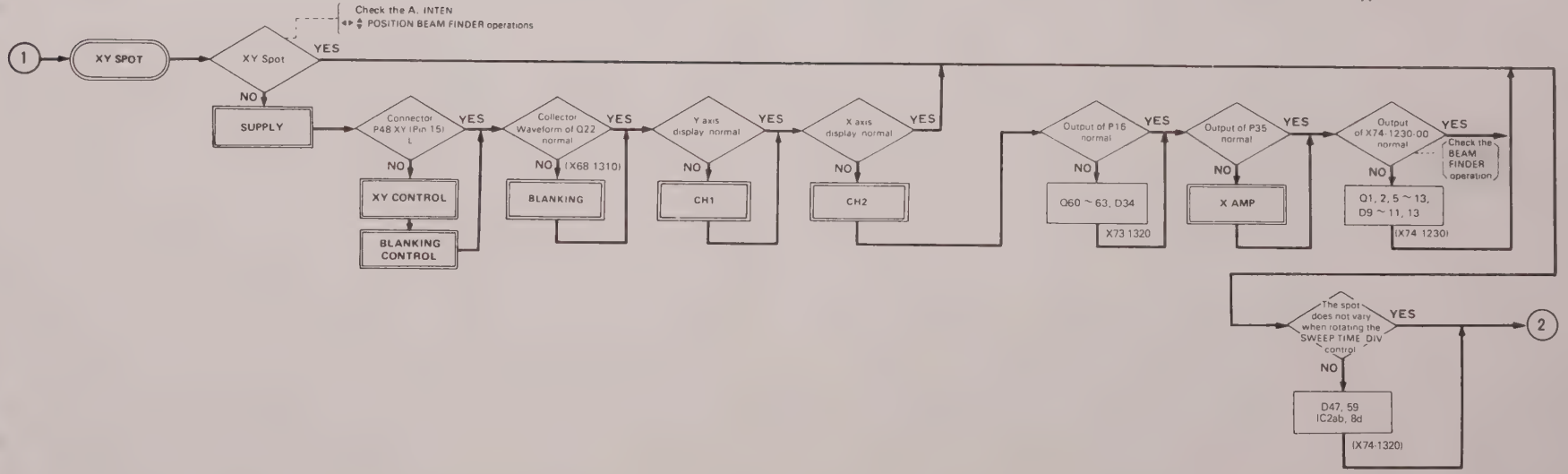
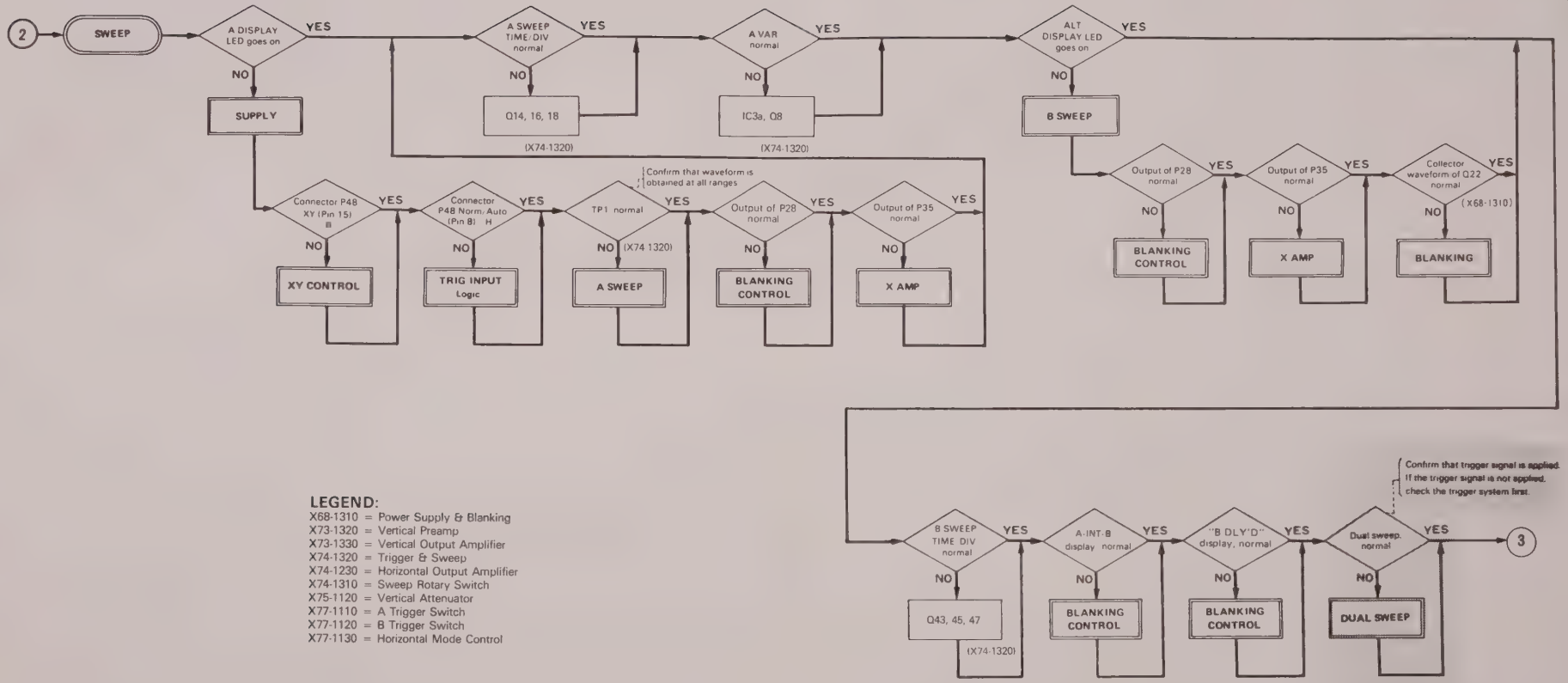


Fig. 29. Troubleshooting Chart (Sheet 1 of 16)



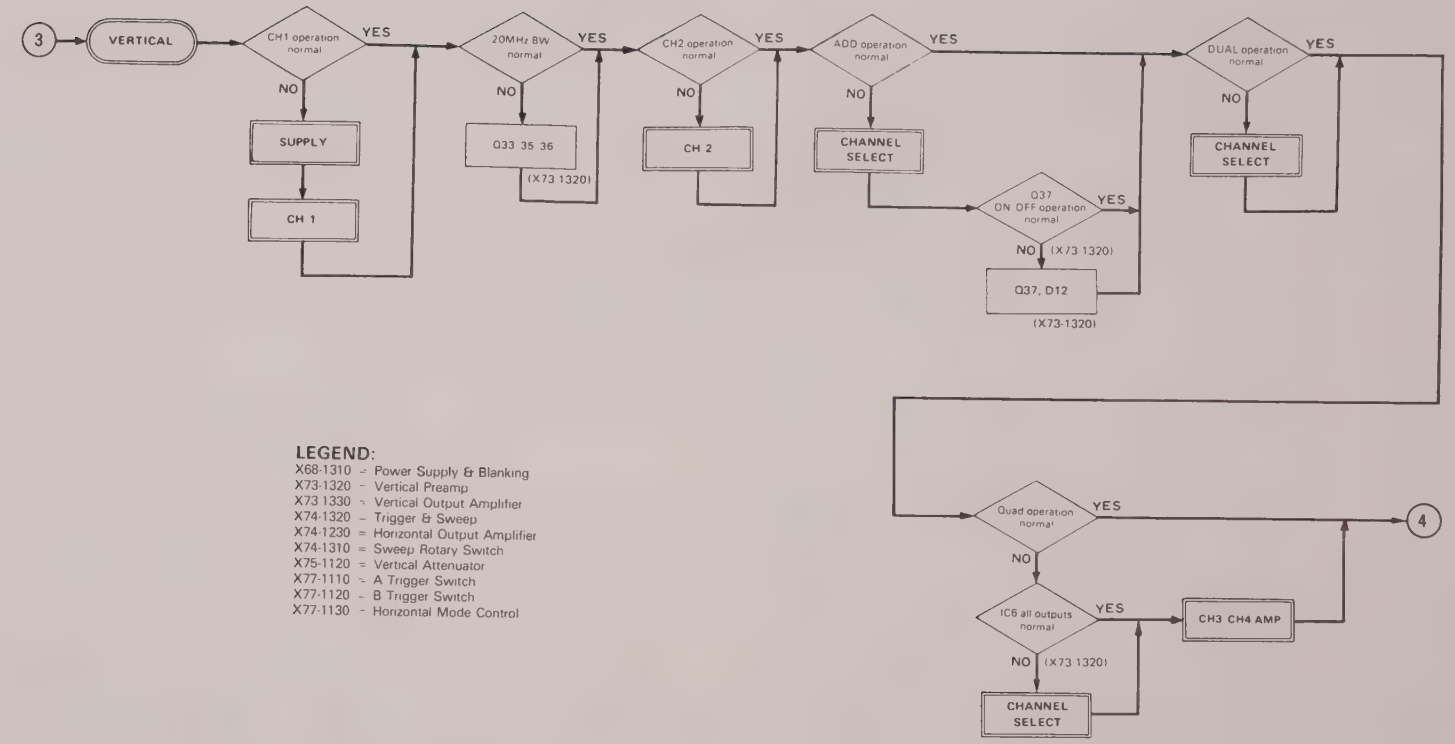
LEGEND:

X68-1310 = Power Supply & Blanking
X73-1320 = Vertical Preamp
X73-1330 = Vertical Output Amplifier
X74-1320 = Trigger & Sweep
X74-1230 = Horizontal Output Amplifier
X74-1310 = Sweep Rotary Switch
X75-1120 = Vertical Attenuator
X77-1110 = A Trigger Switch
X77-1120 = B Trigger Switch
X77-1130 = Horizontal Mode Control

Shaded Area Not Applicable to Model 1570

Fig. 29. Troubleshooting Chart (Sheet 2 of 16)

TROUBLESHOOTING



LEGEND:

X68-1310 - Power Supply & Blanking
X73-1320 - Vertical Preamp
X73 1330 - Vertical Output Amplifier
X74-1320 - Trigger & Sweep
X74-1230 = Horizontal Output Amplifier
X74-1310 = Sweep Rotary Switch
X75-1120 = Vertical Attenuator
X77-1110 - A Trigger Switch
X77-1120 - B Trigger Switch
X77-1130 - Horizontal Mode Control

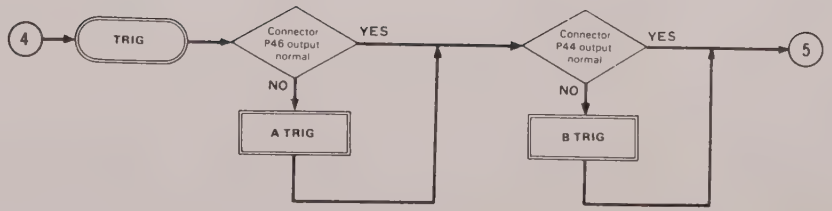
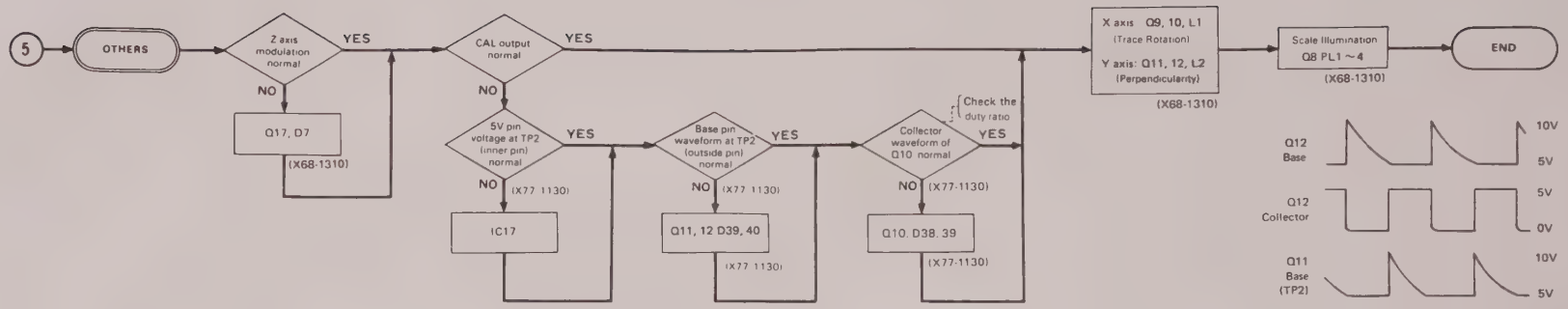


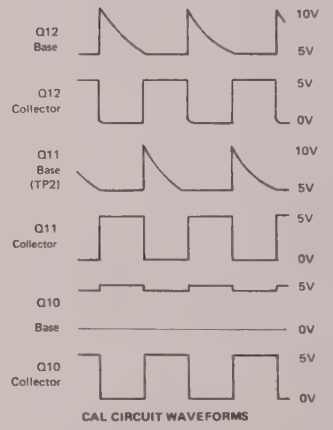
Fig. 29. Troubleshooting Chart (Sheet 3 of 16)



LEGEND:

X68-1310 = Power Supply & Blanking
X73-1320 = Vertical Preamp
X73-1330 = Vertical Output Amplifier
X74-1320 = Trigger & Sweep
X74-1230 = Horizontal Output Amplifier
X74-1310 = Sweep Rotary Switch
X75-1120 = Vertical Attenuator
X77-1110 = A Trigger Switch
X77-1120 = B Trigger Switch
X77-1130 = Horizontal Mode Control

Shaded Area Not Applicable to Model 1570



CAL CIRCUIT WAVEFORMS

(FOR EACH POWER SUPPLY VOLTAGE)

If a power supply voltage is not normal, find the defective unit referring to this flow chart

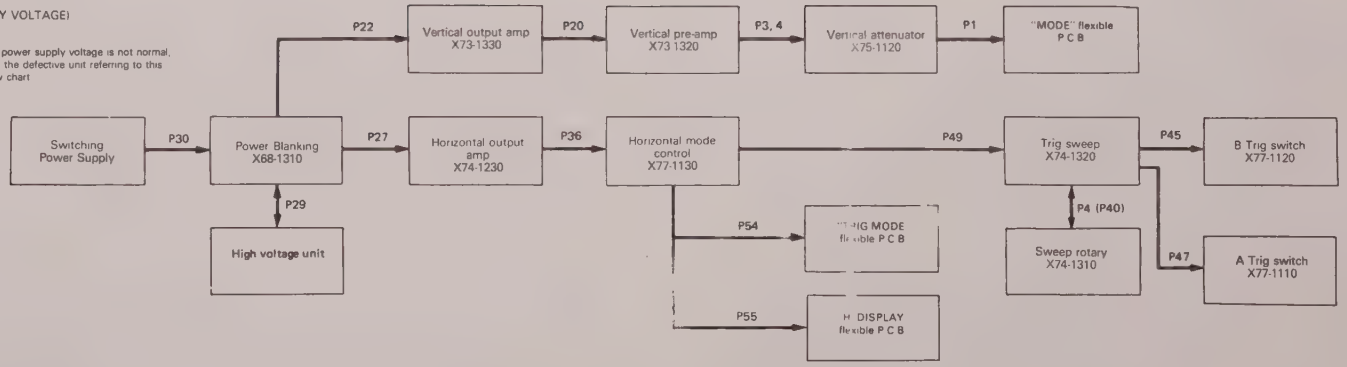
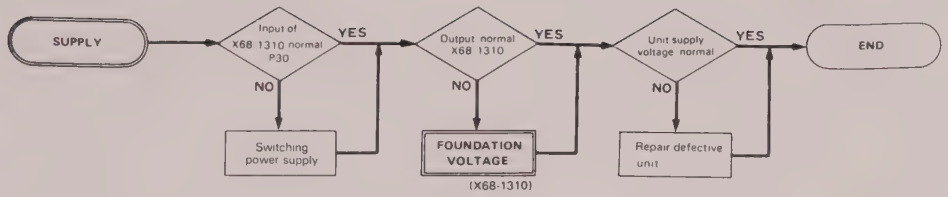


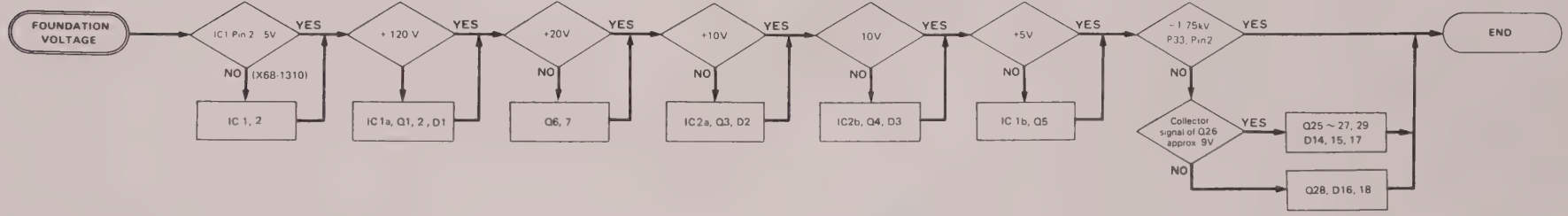
Fig. 29. Troubleshooting Chart (Sheet 4 of 16)

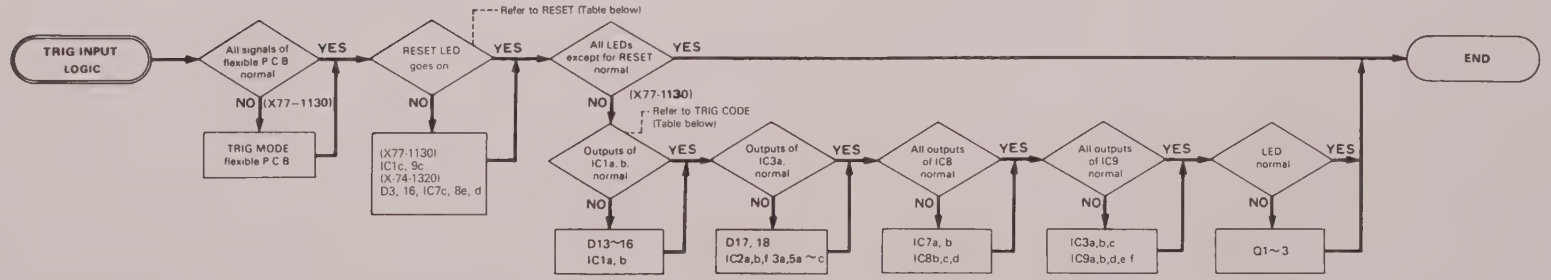
TROUBLESHOOTING



LEGEND:

X68-1310 = Power Supply & Blanking
X73-1320 = Vertical Preamp
X73-1330 = Vertical Output Amplifier
X74-1320 = Trigger & Sweep
X74-1230 = Horizontal Output Amplifier
X74-1310 = Sweep Rotary Switch
X75-1120 = Vertical Attenuator
X77-1110 = A Trigger Switch
X77-1120 = B Trigger Switch
X77-1130 = Horizontal Mode Control





RESET (TRIG MODE "SINGLE")

RESET PUSH (TRIG MODE SINGLE)	Qt	Qt + 1	
	P48 10Pin	IC2b 3 Pin	IC3a 3 Pin
	⌐	L	L

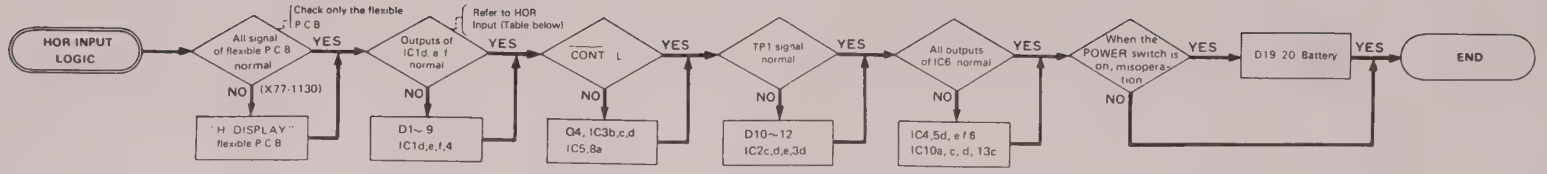
TRIG MODE

TRIG MODE PUSH	Qt			Qt + 1									
	IC1		IC3	IC7			IC8-4	IC8-11	IC8-10	IC9			
	4 Pin	2 Pin	3 Pin	13 Pin	12 Pin	1 Pin	2 Pin	IC5-3	IC5-5	IC5-7	8 Pin	10 Pin	12 Pin	4 Pin	2 Pin
AUTO	⌐	L	⌐	H	L	L	H	L	H	H	H	L	L	H	H
NORM	L	⌐	⌐	L	H	H	L	H	L	H	L	H	L	L	H
SINGLE	⌐	⌐	⌐	H	L	H	L	H	H	L	L	L	H	H	L

Qt = Logic level when switch is pressed.
Qt + 1 = Logic level after switch is pressed (selection latched).

Fig. 29. Troubleshooting Chart (Sheet 5 of 16)

TROUBLESHOOTING



HOR. INPUT

H DISPLAY PUSH	Qt				Qt+1								
	IC1 OUTPUT			IC4 9 PIN	IC5 1 pin / 15 pin	IC4 2 pin / IC5 13 pin	IC4 5 pin / IC5 11 pin	IC4 7 pin / IC5 9 pin	IC6 OUTPUT				
	12 Pin	10 Pin	8 Pin						2	3	4	5	6	7
A	L	L	⌐	⌐	L	L	L	H	L	H	H	H	H	H
ALT	L	⌐	L	⌐	L	L	H	L	H	L	H	H	H	H
A INT-B	L	⌐	⌐	⌐	L	L	H	H	H	H	L	H	H	H
B	⌐	L	L	⌐	L	H	L	L	H	H	H	L	H	H
DUAL	⌐	L	⌐	⌐	L	H	L	H	H	H	H	H	L	H
X-Y	⌐	⌐	L	⌐	L	H	H	L	H	H	H	H	H	L

Qt = Logic level when switch is pressed.
Qt+1 = Logic level after switch is pressed (selection latched).

LEGEND:
X68-1310 = Power Supply & Blanking
X73-1320 = Vertical Preamp
X73-1330 = Vertical Output Amplifier
X74-1320 = Trigger & Sweep
X74-1230 = Horizontal Output Amplifier
X74-1310 = Sweep Rotary Switch
X75-1120 = Vertical Attenuator
X77-1110 = A Trigger Switch
X77-1120 = B Trigger Switch
X77-1130 = Horizontal Mode Control

Shaded Area Not Applicable to Model 1570

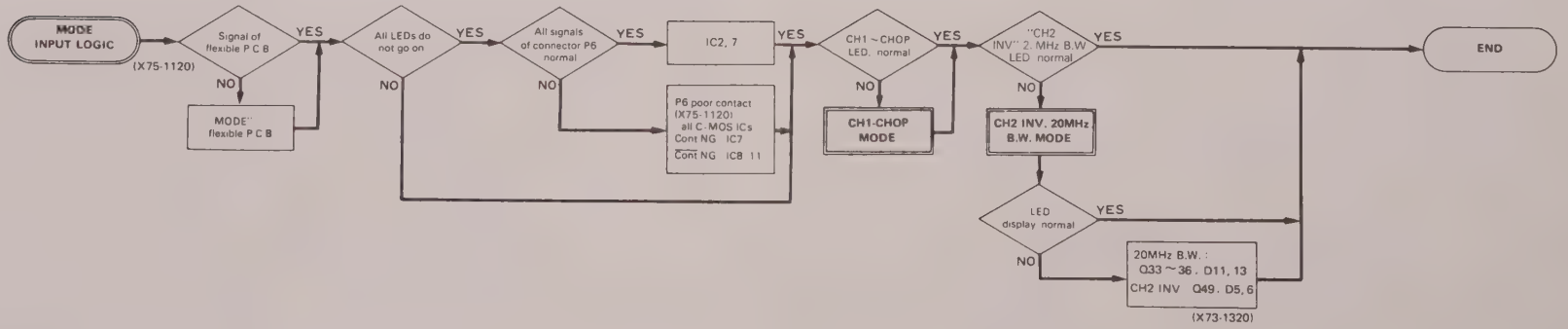
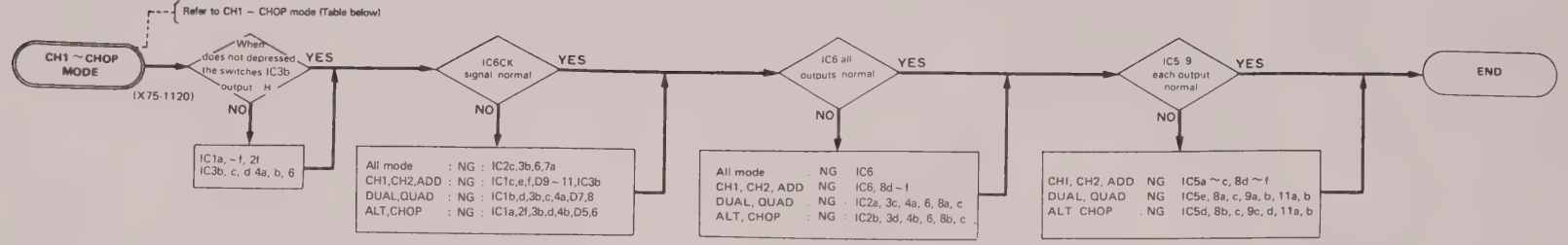
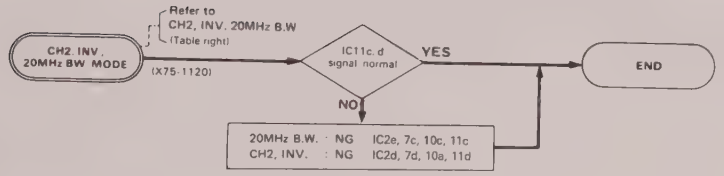

MODE INPUT LOGIC
(X75-1120)
Signal of flexible P C B
MODE" flexible P C B
All LEDs do not go on
All signals of connector P6 normal
P6 poor contact (X75-1120) all C-MOS ICs Cont NG IC7 Cont NG IC8 11
IC2, 7
CH1 ~CHOP LED, normal
CH1-CHOP MODE
"CH2 INV" 2, MHz B.W LED normal
CH2 INV, 20MHz B.W. MODE
LED display normal
20MHz B.W. : Q33~36, D11, 13 CH2 INV Q49, D5, 6
(X73-1320)
END

Fig. 29. Troubleshooting Chart (Sheet 6 of 16)

TROUBLESHOOTING


Refer to CH1 ~ CHOP mode (Table below)
CH1 ~ CHOP MODE
(X75-1120)
When does not depressed the switches IC3b output H
YES
NO
IC1a, ~f, 2f
IC3b, c, d 4a, b, 6
IC6CK signal normal
YES
NO
All mode : NG : IC2c,3b,6,7a
CH1,CH2,ADD : NG : IC1c,e,f,D9 ~ 11,IC3b
DUAL,QUAD : NG : IC1b,d,3b,c,4a,D7,8
ALT,CHOP : NG : IC1a,2f,3b,d,4b,D5,6
IC6 all outputs normal
YES
NO
All mode NG IC6
CH1, CH2, ADD NG IC6, 8d ~ f
DUAL, QUAD NG IC2a, 3c, 4a, 6, 8a, c
ALT, CHOP : NG : IC2b, 3d, 4b, 6, 8b, c
IC5 9 each output normal
YES
NO
CH1, CH2, ADD NG IC5a ~ c, 8d ~ f
DUAL, QUAD NG IC5e, 8a, c, 9a, b, 11a, b
ALT CHOP NG IC5d, 8b, c, 9c, d, 11a, b
END

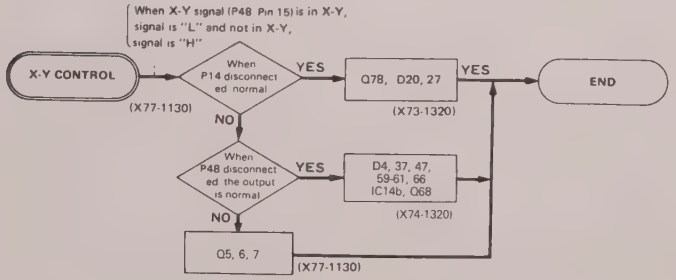

Refer to CH2, INV. 20MHz B.W (Table right)
CH2 INV. 20MHz BW MODE
(X75-1120)
IC11c. d signal normal
YES
NO
20MHz B.W. : NG IC2e, 7c, 10c, 11c
CH2, INV. : NG IC2d, 7d, 10a, 11d
END

CH2 INV.

	Qt	Qt + 1
CH2 INV PUSH	IC10a INPUT (T)	IC10a OUTPUT (Q)
	⌐	Y

20MHz B.W.

	Qt	Qt + 1
20MHz B.W PUSH	IC 10b INPUT (T)	IC10b OUTPUT (Q)
	⌐	Y



CH1 ~ CHOP MODE

"MODE" PUSH	Qt				Qt + 1															
	IC3a IN OUT			IC6	CH1 / CH2 / ADD						IC6	DUAL / QUAD				ALT CHOP				
	IN Pin	IN Pin	OUT Pin	CK	IC6			IC5			Q2	IC4a Q	IC6 Qo	IC9 OUTPUT		IC4b Q	IC6 Q1	IC9 OUTPUT	
	5	6	4		Q5	Q4	Q3	a	b	c				b	a			c	d
CH1	L	⌐	L	⌐	H	L	L	L	H	H	H	X	X	H	H	X	X	H	H
CH2	L	⌐	L	⌐	L	H	L	H	L	H	H	X	X	H	H	X	X	H	H
DUAL	⌐	L	L	⌐	L	L	L	H	H	H	L	L	L	L	H	X	X	X	X
ADD	L	⌐	L	⌐	L	L	H	H	H	L	H	X	X	H	H	X	X	H	H
QUAD	⌐	L	L	⌐	L	L	L	H	H	H	L	H	H	H	L	X	X	X	X
ALT	⌐	L	L	⌐	L	L	L	H	H	H	L	X	X	X	X	H	L	L	H
CHOP	⌐	L	L	⌐	L	L	L	H	H	H	L	X	X	X	X	L	H	H	L

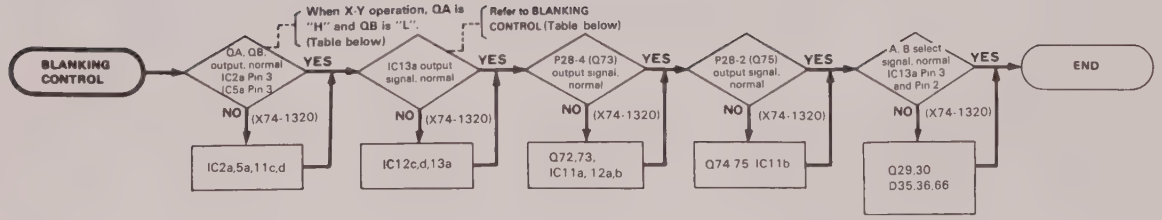
Qt = Logic level when switch is pressed.
Qt + 1 = Logic level after switch is pressed (selection latched).
X = H or L, Logic level doesn't change from previous state
Y = H or L, but opposite logic level from previous state.

LEGEND:

X68-1310 = Power Supply & Blanking
X73-1320 = Vertical Preamp
X73-1330 = Vertical Output Amplifier
X74-1320 = Trigger & Sweep
X74-1230 = Horizontal Output Amplifier
X74-1310 = Sweep Rotary Switch
X75-1120 = Vertical Attenuator
X77-1110 = A Trigger Switch
X77-1120 = B Trigger Switch
X77-1130 = Horizontal Mode Control

Fig. 29. Troubleshooting Chart (Sheet 7 of 16)

TROUBLESHOOTING



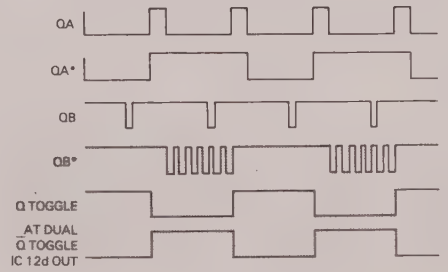
LEGEND:

X68-1310 = Power Supply & Blanking
X73-1320 = Vertical Preamp
X73-1330 = Vertical Output Amplifier
X74-1320 = Trigger & Sweep
X74-1230 = Horizontal Output Amplifier
X74-1310 = Sweep Rotary Switch
X75-1120 = Vertical Attenuator
X77-1110 = A Trigger Switch
X77-1120 = B Trigger Switch
X77-1130 = Horizontal Mode Control

BLANKING CONTROL

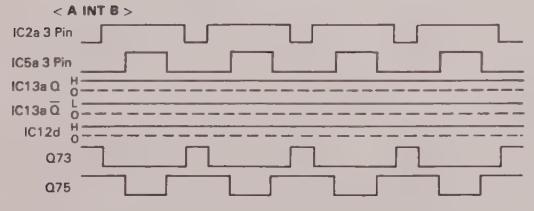
H DISPLAY	P48 X-Y BUFFER 15Pin	IC13a IN S	IC13a IN R	IC13a OUT Q	IC13a OUT $\overline{Q}$	IC12d OUT	P28 A blanking 4 Pin	P28 B blanking 2 Pin
A	H	H	L	H	L	H	QA	H
ALT	H	L	L	TOGGLE		H	QA*	QB
A-INT-B	H	H	L	H	L	H	QA	QB
B-DLY'D	H	L	H	L	H	H	H	QB
DUAL	H	L	L	TOGGLE		TOGGLE	QA*	QB*
X-Y	L	H	L	H	L	H	L	H

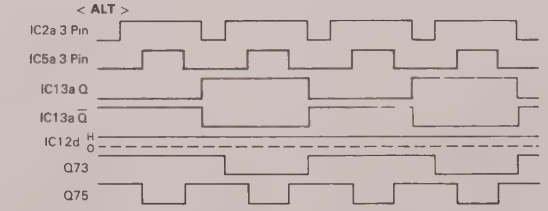
*1 Complex waveform IC 11b and QA signals.
*2 Complex waveform IC11b output. When CHOP operation, output of P28 is complex CHOP signal waveform



RELATIONSHIP BETWEEN A, B SWEEP AND QA, QB

Shaded Area Not Applicable to Model 1570





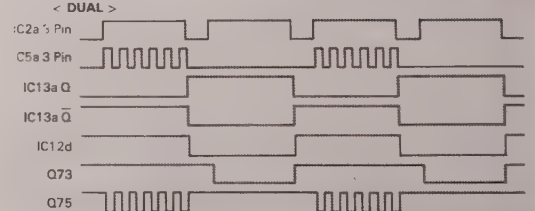
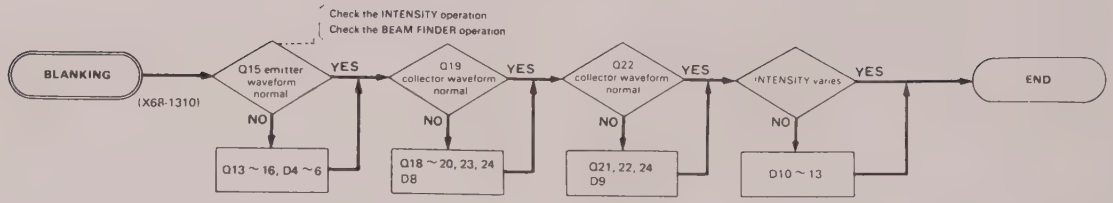
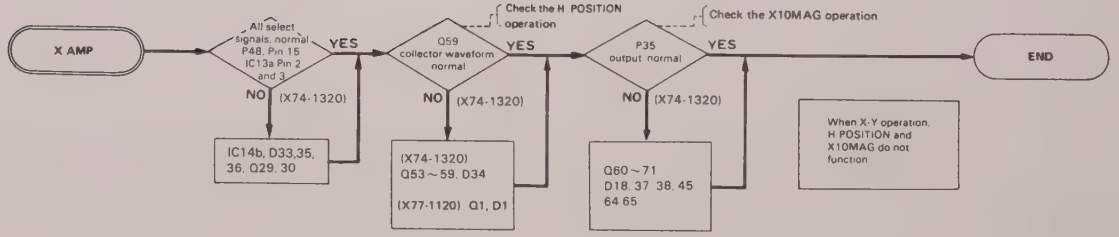


Fig. 29. Troubleshooting Chart (Sheet 8 of 16)

TROUBLESHOOTING



Shaded Area Not Applicable to Model 1570


X AMP
All select signals, normal P48, Pin 15 IC13a Pin 2 and 3
YES
NO (X74-1320)
IC14b, D33,35, 36, Q29, 30
Check the H POSITION operation
Q59 collector waveform normal
YES
NO (X74-1320)
(X74-1320) Q53 ~ 59, D34
(X77-1120) Q1, D1
Check the X10MAG operation
P35 output normal
YES
NO (X74-1320)
Q60 ~ 71 D18, 37, 38, 45 64 65
When X-Y operation, H POSITION and X10MAG do not function
END

LEGEND:

X68-1310 = Power Supply & Blanking
X73-1320 = Vertical Preamp
X73-1330 = Vertical Output Amplifier
X74-1320 = Trigger & Sweep
X74-1230 = Horizontal Output Amplifier
X74-1310 = Sweep Rotary Switch
X75-1120 = Vertical Attenuator
X77-1110 = A Trigger Switch
X77-1120 = B Trigger Switch
X77-1130 = Horizontal Mode Control

Fig. 29. Troubleshooting Chart (Sheet 9 of 16)

LEGEND:
X68-1310 = Power Supply & Blanking
X73-1320 = Vertical Preamp
X73-1330 = Vertical Output Amplifier
X74-1320 = Trigger & Sweep
X74-1230 = Horizontal Output Amplifier
X74-1310 = Sweep Rotary Switch
X75-1120 = Vertical Attenuator
X77-1110 = A Trigger Switch
X77-1120 = B Trigger Switch
X77-1130 = Horizontal Mode Control

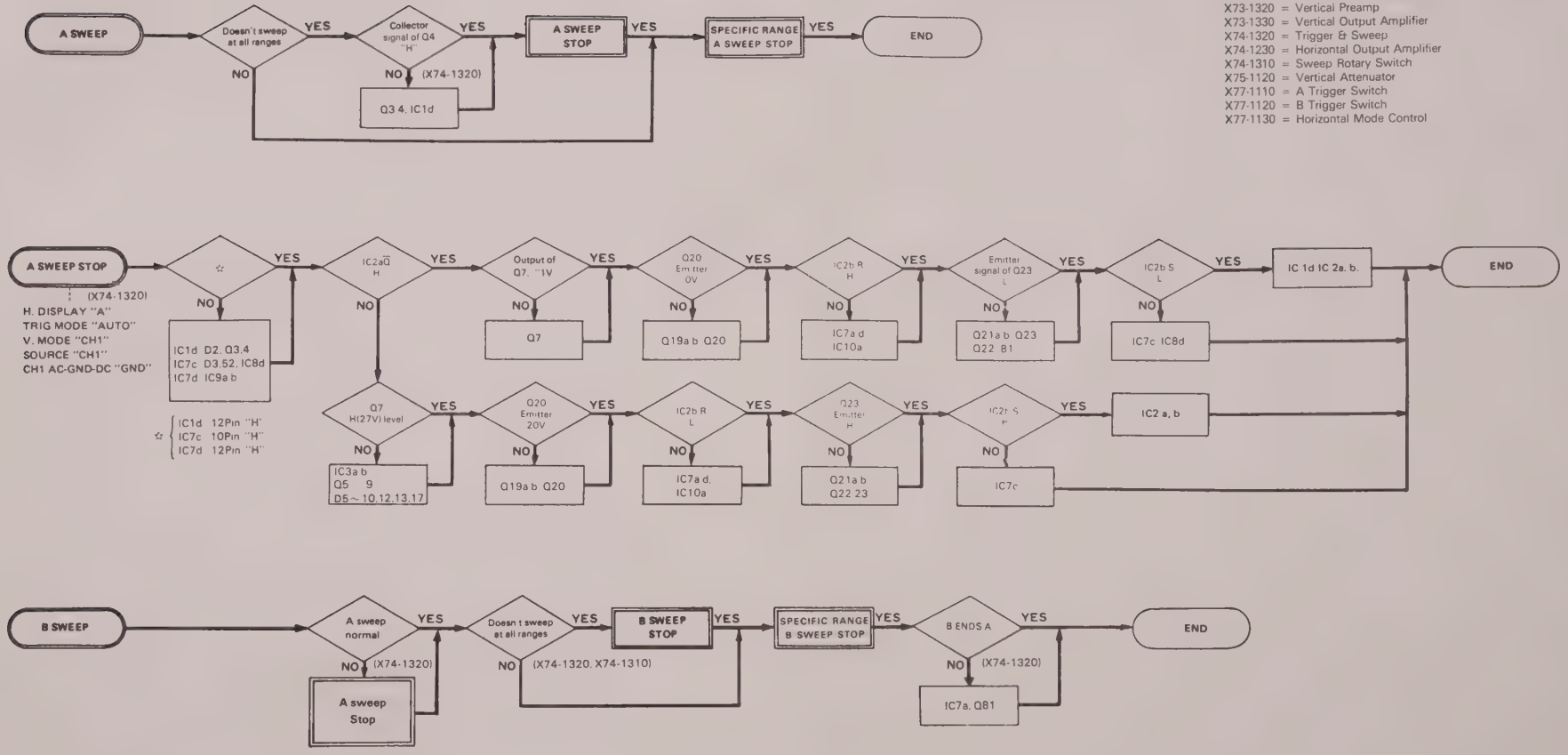
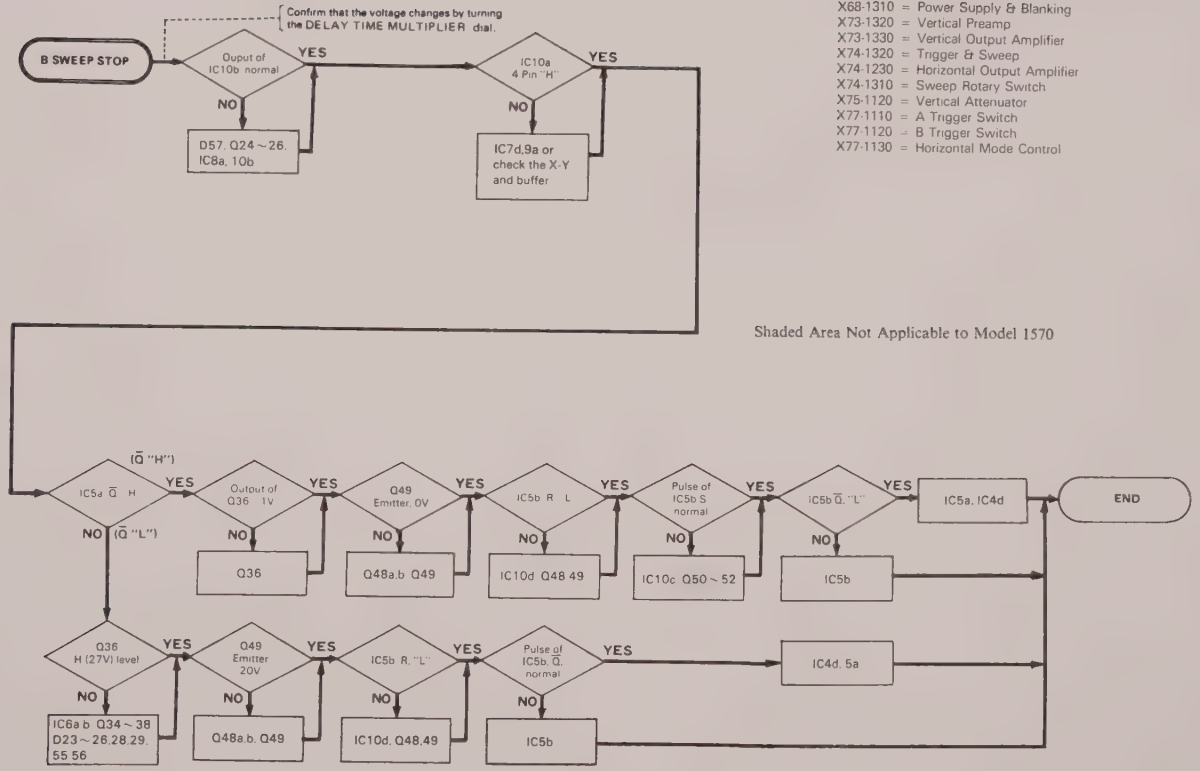


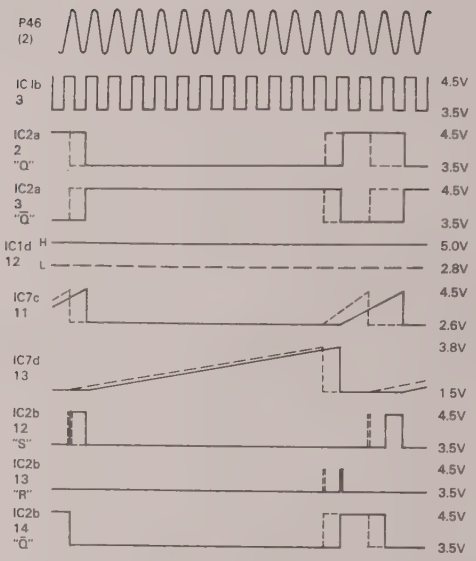
Fig. 29. Troubleshooting Chart (Sheet 10 of 16)



LEGEND:

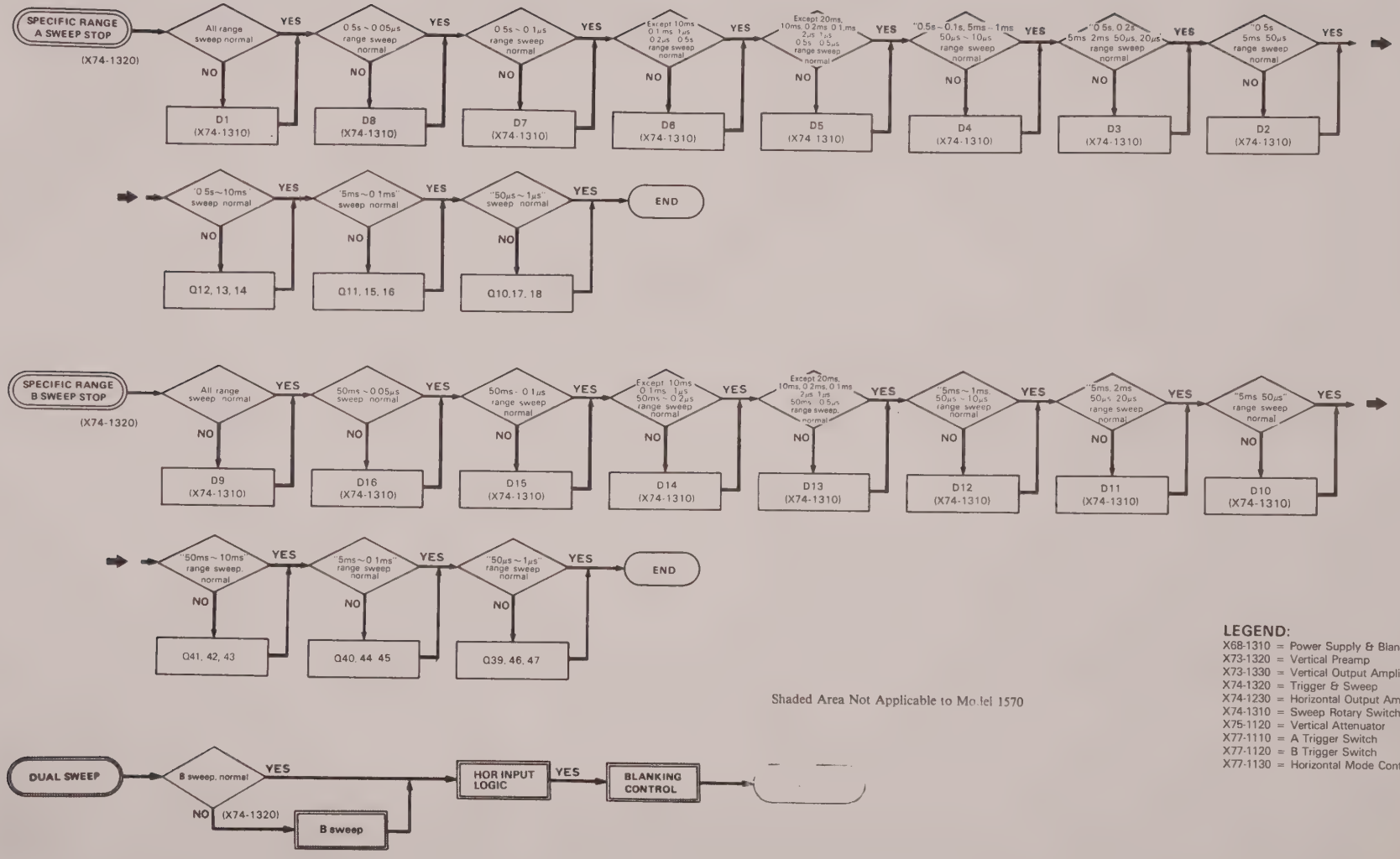
X68-1310 = Power Supply & Blanking
X73-1320 = Vertical Preamp
X73-1330 = Vertical Output Amplifier
X74-1320 = Trigger & Sweep
X74-1230 = Horizontal Output Amplifier
X74-1310 = Sweep Rotary Switch
X75-1120 = Vertical Attenuator
X77-1110 = A Trigger Switch
X77-1120 = B Trigger Switch
X77-1130 = Horizontal Mode Control

Waveform in Sweep circuit (X74-1320-00)
(Input signal 1 kHz, SWEEP TIME 1 ms/div)



Broken-line auto free run
(at non-signal)

Fig. 29. Troubleshooting Chart (Sheet 11 of 16)

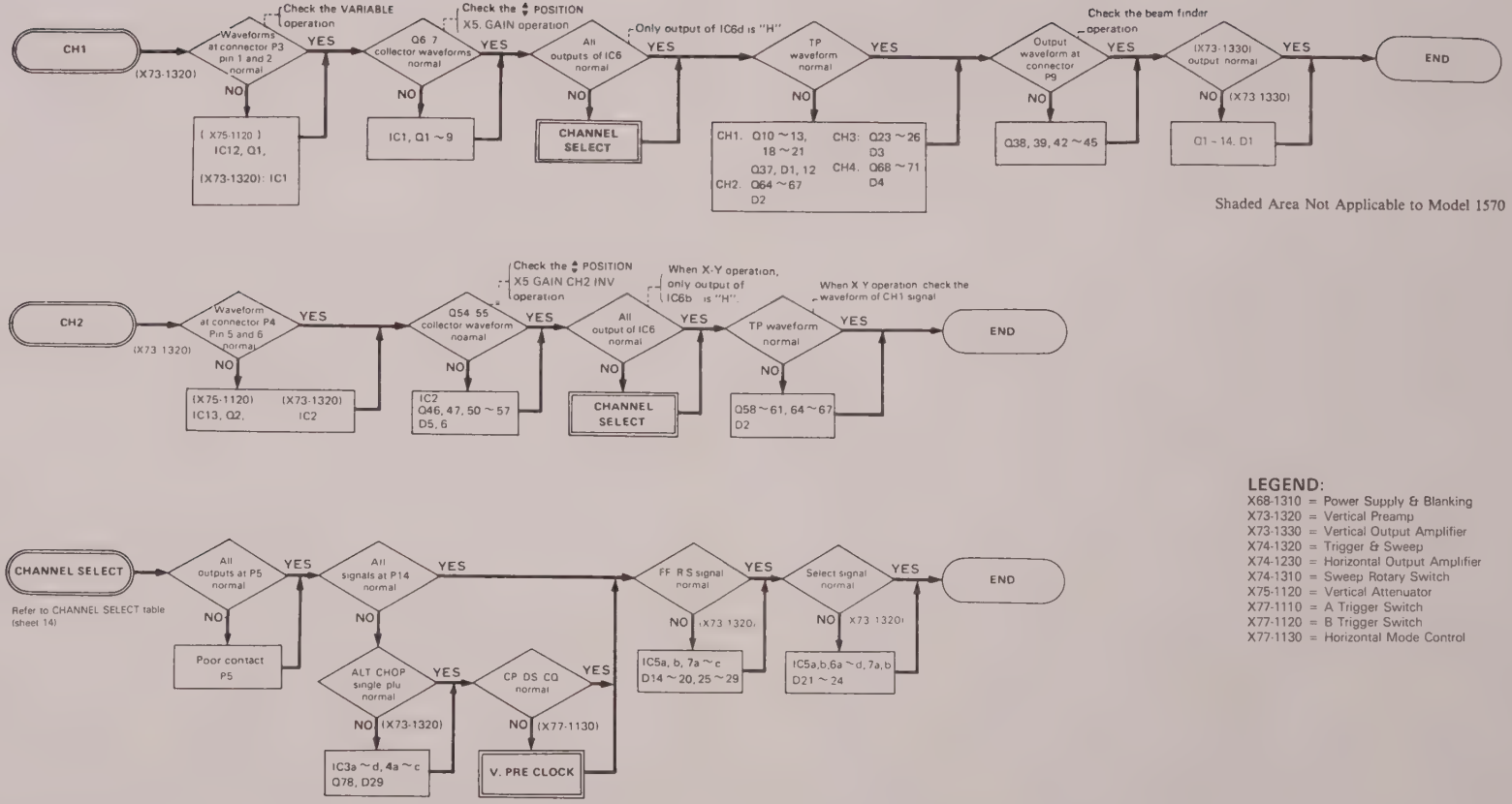

SPECIFIC RANGE A SWEEP STOP
(X74-1320)
All range sweep normal
0.5s ~ 0.05μs range sweep normal
0.5s ~ 0.1μs range sweep normal
Except 10ms, 1ms, 0.2μs, 0.5s range sweep normal
Except 20ms, 10ms, 0.2ms, 0.1ms, 2μs, 1μs, 0.5s, 0.5μs range sweep normal
"0.5s ~ 0.1s, 5ms ~ 1ms 50μs ~ 10μs range sweep normal
"0.5s, 0.2s, 5ms, 2ms, 50μs, 20μs range sweep normal
"0.5s, 5ms, 50μs range sweep normal
YES
NO
D1 (X74-1310)
D8 (X74-1310)
D7 (X74-1310)
D6 (X74-1310)
D5 (X74-1310)
D4 (X74-1310)
D3 (X74-1310)
D2 (X74-1310)
"0.5s ~ 10ms sweep normal
"5ms ~ 0.1ms" sweep normal
"50μs ~ 1μs" sweep normal
END
Q12, 13, 14
Q11, 15, 16
Q10, 17, 18
SPECIFIC RANGE B SWEEP STOP
(X74-1320)
All range sweep normal
50ms ~ 0.05μs sweep normal
50ms ~ 0.1μs range sweep normal
Except 10ms, 1ms, 50ms ~ 0.2μs range sweep normal
Except 20ms, 10ms, 0.2ms, 0.1ms, 2μs, 1μs, 50ms ~ 0.5μs range sweep normal
"5ms ~ 1ms, 50μs ~ 10μs range sweep normal
"5ms, 2ms, 50μs, 20μs range sweep normal
"5ms, 50μs" range sweep normal
D9 (X74-1310)
D16 (X74-1310)
D15 (X74-1310)
D14 (X74-1310)
D13 (X74-1310)
D12 (X74-1310)
D11 (X74-1310)
D10 (X74-1310)
"50ms ~ 10ms" range sweep normal
"5ms ~ 0.1ms" range sweep normal
"50μs ~ 1μs" range sweep normal
END
Q41, 42, 43
Q40, 44, 45
Q39, 46, 47
Shaded Area Not Applicable to Model 1570
DUAL SWEEP
B sweep, normal
(X74-1320)
B sweep
HOR INPUT LOGIC
BLANKING CONTROL

LEGEND:

X68-1310 = Power Supply & Blanking
X73-1320 = Vertical Preamp
X73-1330 = Vertical Output Amplifier
X74-1320 = Trigger & Sweep
X74-1230 = Horizontal Output Amplifier
X74-1310 = Sweep Rotary Switch
X75-1120 = Vertical Attenuator
X77-1110 = A Trigger Switch
X77-1120 = B Trigger Switch
X77-1130 = Horizontal Mode Control

Fig. 29. Troubleshooting Chart (Sheet 12 of 16)

TROUBLESHOOTING


CH1
(X73-1320)
Waveforms at connector P3 pin 1 and 2 normal
Check the VARIABLE operation
YES
NO
(X75-1120) IC12, Q1, (X73-1320): IC1
Q6 7 collector waveforms normal
Check the ▲▼ POSITION X5. GAIN operation
IC1, Q1 ~ 9
All outputs of IC6 normal
Only output of IC6d is "H"
CHANNEL SELECT
TP waveform normal
CH1. Q10 ~ 13, 18 ~ 21, Q37, D1, 12
CH2. Q64 ~ 67, D2
CH3: Q23 ~ 26, D3
CH4. Q68 ~ 71, D4
Output waveform at connector P9
Check the beam finder operation
Q38, 39, 42 ~ 45
(X73-1330) output normal
(X73 1330)
Q1 ~ 14. D1
END
CH2
(X73 1320)
Waveform at connector P4 Pin 5 and 6 normal
(X75-1120) IC13, Q2,
(X73-1320) IC2
Q54 55 collector waveform noamal
Check the ▲▼ POSITION X5 GAIN CH2 INV operation
IC2 Q46, 47, 50 ~ 57 D5, 6
All output of IC6 normal
When X-Y operation, only output of IC6b is "H".
CHANNEL SELECT
TP waveform normal
When X Y operation check the waveform of CH1 signal
Q58 ~ 61, 64 ~ 67 D2
END
CHANNEL SELECT
Refer to CHANNEL SELECT table (sheet 14)
All outputs at P5 normal
Poor contact P5
All signals at P14 normal
ALT CHOP single plu normal
(X73-1320)
IC3a ~ d, 4a ~ c Q78, D29
CP DS CQ normal
(X77-1130)
V. PRE CLOCK
FF R S signal normal
(X73 1320)
IC5a, b, 7a ~ c D14 ~ 20, 25 ~ 29
Select signal normal
(X73 1320)
IC5a,b,6a ~ d, 7a,b D21 ~ 24
END

Shaded Area Not Applicable to Model 1570

LEGEND:

X68-1310 = Power Supply & Blanking
X73-1320 = Vertical Preamp
X73-1330 = Vertical Output Amplifier
X74-1320 = Trigger & Sweep
X74-1230 = Horizontal Output Amplifier
X74-1310 = Sweep Rotary Switch
X75-1120 = Vertical Attenuator
X77-1110 = A Trigger Switch
X77-1120 = B Trigger Switch
X77-1130 = Horizontal Mode Control

Fig. 29. Troubleshooting Chart (Sheet 13 of 16)

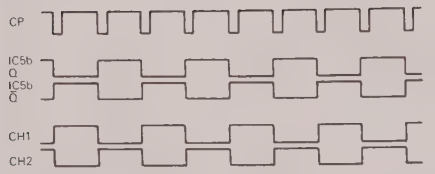


Fig. A. (Synchronized with the CP signal regardless of the DS signal)

CHANNEL SELECT

SWEEP OPERATION			MODE INPUT (P5)								VERTICAL CLOCK (P14)								FLIP-FLOP PRESET CLEAR signal		FLIP-FLOP OUTPUT signal				CHANNEL SELECT signal			
			CH1	CH2	CH3	CH4	ADD ALT	ALT CHOP	Single Sweep	CP	DS	DS̄	CH1	CH2	CH3	CH4	ADD ALT	ALT CHOP	CH1 R	CH2 R	CH1 Q	CH2 Q	CH3 Q	CH4 Q	CH1	CH2	CH3	CH4
Except DUAL SWEEP																												
		CH1																										
		CH2																										
		ADD																										
DUAL SWEEP	DUAL	ALT																			TOGGLE				Fig A			
		CHOP																										
	QUAD	ALT CHOP																			TOGGLE	TOGGLE			Fig B			
DUAL SWEEP	DUAL	ALT																							Fig C			
		CHOP																										
	QUAD	ALT CHOP																			TOGGLE				Fig D			
X Y operation																												

(Note) "X" H or L
CP signal is CHOP signal, or coincident with sweep for ALT.

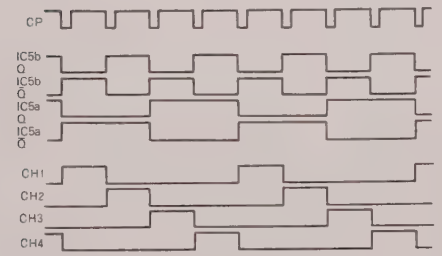


Fig. B. (Synchronized with CP signal regardless of the DS signal)

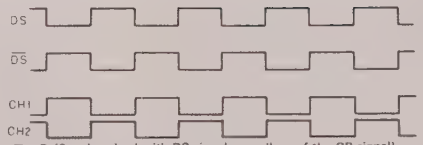


Fig. C. (Synchronized with DS signal regardless of the CP signal)

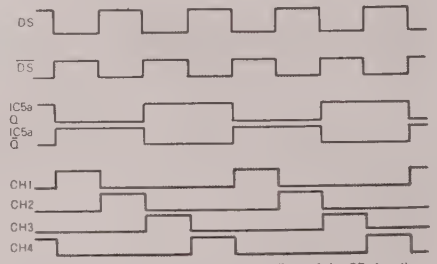
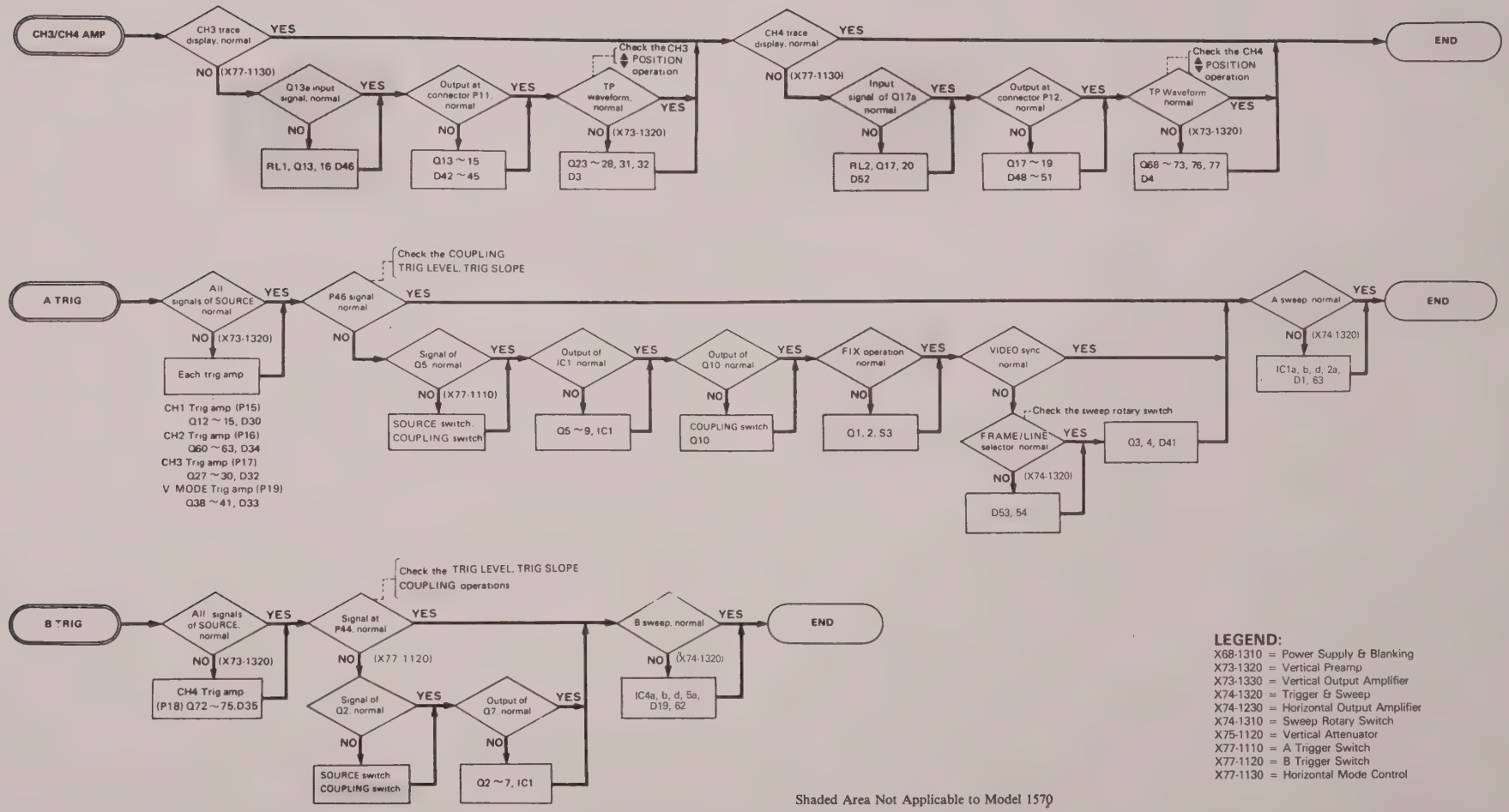


Fig. D. (Synchronized with DS signal regardless of the CP signal)

Shaded Area Not Applicable to Model 1570

Fig. 29. Troubleshooting Chart (Sheet 14 of 16)

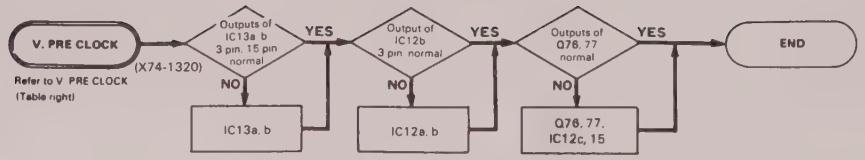


Shaded Area Not Applicable to Model 1570

LEGEND:

X68-1310 = Power Supply & Blanking
X73-1320 = Vertical Preamp
X73-1330 = Vertical Output Amplifier
X74-1320 = Trigger & Sweep
X74-1230 = Horizontal Output Amplifier
X74-1310 = Sweep Rotary Switch
X75-1120 = Vertical Attenuator
X77-1110 = A Trigger Switch
X77-1120 = B Trigger Switch
X77-1130 = Horizontal Mode Control

Fig. 29. Troubleshooting Chart (Sheet 15 of 16)



LEGEND:

X68-1310 = Power Supply & Blanking
X73-1320 = Vertical Preamp
X73-1330 = Vertical Output Amplifier
X74-1320 = Trigger & Sweep
X74-1230 = Horizontal Output Amplifier
X74-1310 = Sweep Rotary Switch
X75-1120 = Vertical Attenuator
X77-1110 = A Trigger Switch
X77-1120 = B Trigger Switch
X77-1130 = Horizontal Mode Control

V. PRE CLOCK

			INPUT		OUTPUT				
	MODE		ALT CHOP	Signal PRu	IC14d	IC15a,b	IC15c,d	CP	DS*4
SWEEP Operation	CH1		L	L	H	Refer to the right table	QA*1	$\overline{QA}$*2	H
	CH2		L	L	H		QA*1	$\overline{QA}$*2	H
	DUAL	ALT	L	H	H		QA*1	$\overline{QA}$*2	H
		CHOP	H		L		CHOP Osc	CHOP Pulse	H
	ADD		L	L	H		QA*1	$\overline{QA}$*2	H
	QUAD	ALT	L	H	H		QA*1	$\overline{QA}$*2	H
		CHOP	H		L		CHOP Osc	CHOP Pulse	H
X-Y Operation			DUAL, ALT / QUAD, ALT / OTHER	L / H	DUAL, ALT / QUAD, ALT / OTHER	H / L	CHOP Osc *3	CHOP Pulse *3	H

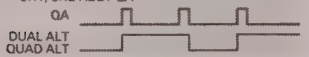
Each signal of IC16a, CP, DS vary by H. DISPLAY.

H DISPLAY	IC15b 7 Pin	IC15b 8 Pin	IC15a, b OUTPUT	CQ	IC13a Q
A	L	L	QA	L	H
ALT	H	L	L	L	*5
A-INT-B	L	L	QA	L	H
B DLY'D	L	L	QA	L	L
DUAL	H	L	QA	H	*5
X-Y	H	L	L	L	H

Shaded Area Not Applicable to Model 1570

*1. H. DISPLAY: ALT
CH1, CH2 ADD: L

H. DISPLAY: DUAL
CH1, CH2 ADD: QA

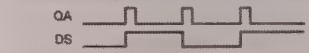


*2. H. DISPLAY: ALT
CH1, CH2 ADD: H

H. DISPLAY: DUAL
CH1 CH2 ADD: QA

*3. MODE: DUAL ALT, QUAD ALT: L

*4. H. DISPLAY: DUAL



*5. Waveform

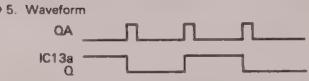


Fig. 29. Troubleshooting Chart (Sheet 16 of 16)

PARTS LIST

This section includes exploded views of the oscilloscope with accompanying mechanical parts list, a packing drawing with accompanying parts list, and an electrical parts list referenced to the schematic diagrams.

U.S.A. PARTS ORDERING INFORMATION

There is a minimum charge for each invoice. Orders will be shipped C.O.D. unless previous open account arrangements have been made or remittance accompanies order. Advance remittance must cover handling, postage or express charges. Specify model and serial number when ordering replacement parts.

ORDER REPLACEMENT PARTS FROM

B & K-Precision, Factory Service Operations
Maxtec International Corporation
6470 West Cortland Street
Chicago, Illinois 60635

MECHANICAL PARTS

INDEX NO.	SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.
		(Parts Shown in Fig. 30)	
30 -1		Frame, LH	254-064-9-001
-2		Frame, RH	254-050-9-001
-3		Die-Cast Panel	255-204-9-001
-4 *		Decorative Panel, CH 1, CH 2 (LH)	260-275-9-001
-4 **		Decorative Panel, CH 1, CH 2 (LH)	260-326-9-001
-5 *		Decotative Panel, Sweep (RH)	260-276-9-001
-5 **		Decotative Panel, Sweep (RH)	260-327-9-001
-6		Decorative Panel, Intensity (Center)	260-277-9-001
-7		Sub-Panel (RH)	254-052-9-001
-8		Rear Panel	262-035-9-001
-9		Reflector (Illumination)	261-155-9-001
-10		Spacer	763-083-9-001
-11		Escutcheon (PUSH 50Ω)	769-115-9-002
-12 *		Filter	380-407-9-001
-12 **		Filter	380-441-9-001
-13 *		Floating Core (SWEEP TIME Switch)	380-407-9-002
-13 **		Floating Core (SWEEP TIME Switch)	380-441-9-002
-14		LED, POWER	400-072-9-001
-15 *		Power Connector	773-125-9-001
-15 **		Power Connector	770-019-9-001
-16		BNC Receptacle, Jack	773-090-9-001
-17		CAL Terminal	345-059-9-001
-18 *		Current CAL Terminal	345-066-9-001
-18 **		Blind Cover	253-106-9-001
-19		GND Terminal	345-065-9-001
-20		Teflon Terminal	757-030-9-003
-21 *		Ground Lug	740-009-9-001
-22		Ground Lug	740-026-9-001
-23		Ground Lug	740-032-9-003
-24		Fuse, 1.2 A	191-017-9-001
-25		Felt	351-005-9-001
-26		Spacer (CRT Mount)	253-093-9-001
-27 *		Insulator (Current CAL Terminal	342-082-9-003
-28		Fuse Holder	742-040-9-001
-29		Switch Locking Plate	741-143-9-001
-30		Locking Ring (SWEEP TIME Switch)	251-510-9-001
-31		Bracket, Delay Line	251-558-9-001
-32		Retainer Clamp (CRT Mount)	261-157-9-001
-33		Spacer (A, B Trigger Level)	759-116-9-002
-34		Mounting Rubber (for CRT)	381-100-9-002
-35		Mounting Rubber (for CRT)	381-100-9-003
-36		Mounting Rubber (for Lamp)	381-100-9-004
-37		Wire Saddle	763-166-9-003
-38		Knob, VOLTS/DIV	751-186-9-001
-39		Knob, VARIABLE	751-207-9-001
-40		Knob, SLOPE, etc.	751-207-9-002

* = Used only in Model 1590
** = Used only in Model 1570

INDEX NO.	SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.
		Parts Shown in Fig. 30 (continued)	
30 -41		Knob, V. POSITION, etc.	751-207-9-003
-42		Knob, TRIG LEVEL, etc.	751-207-9-004
-43		Knob, A SWEEP TIME/DIV	751-207-9-005
-44		Knob, B SWEEP TIME/DIV	751-207-9-006
-45		Knob, Lever Switch	751-186-9-004
-46	L3	Delay Line	040-001-9-001
-47	S29	Slide Switch (Line Voltage Select)	084-022-9-003
-48		Power Thermistor, 4W-25V	005-007-9-001
-49	VR1/S21	Variable Resistor with Switch, 3 kΩ, V. POSITION	008-406-9-001
-49	VR2/S22	Variable Resistor with Switch, 3 kΩ, V. POSITION	008-406-9-001
-50	VR4/S28	Variable Resistor with Switch, 5 kΩ, H. POSITION	008-406-9-002
-51	VR3	Variable Resistor, 5 kΩ, HOLDOFF	008-406-9-003
-52	VR5	Potentiometer, Multi-Turn, 1 kΩ, DELAY TIME MULTIPLIER	008-406-9-004
-53		RF Shield Gasket	769-125-9-001
-54		Shield Plate (CH 3 Input)	256-159-9-001
-55		Ground Strap (HV Pwr Supply)	256-159-9-002
-56		Spring (VOLTS/DIV Control)	767-117-9-001
-57		PCB Support	759-135-9-001
-58		Interconnect Printed Circuit Board (Trig. Mode)	302-553-9-001
-59		Shield Case, Switching Power Supply	256-152-9-001
-60 *		High Voltage Power Supply	523-459-9-001
-60 **		High Voltage Power Supply	157-022-9-001
-61		Switching Power Supply	523-433-9-001
-62		Power Supply & Blanking Assy	523-475-9-001
-63	VR1	Variable Resistor, 10 KΩ, ILLUM	008-406-9-006
-64	VR8	Variable Resistor, 3 MΩ, FOCUS	008-390-9-001
-65	VR4	Variable Resistor, Dual 1 kΩ, A INTENSITY, B INTENSITY	008-406-9-005
-66		Heat Sink	747-094-9-006
-67		Bracket, Variable Resistor	251-512-9-001
-68		Vertical Preamplifier Assy	523-467-9-001
-69		Vertical Output Amplifier Assy	523-468-9-001
-70		Heat sink	747-094-9-004
-71		Trigger & Sweep Assy	523-489-9-001
-72		Horizontal Output Amplifier Assy	523-474-9-001
-73		Heat Sink	747-094-9-003
-74		Sweep Rotary Switch Assy	523-489-9-002
-75 *		Rotary Switch	083-289-9-001
-75 **		Rotary Switch	083-286-9-002
-76		Vertical Attenuator Assy	523-466-9-001
-77 *		A Trigger Switch Assy	523-510-9-001
-77 **		A Trigger Switch Assy	523-470-9-001
-78 *	S1	Lever Switch, SOURCE	080-014-9-001

* = Used only in Model 1590
** = Used only in Model 1570

INDEX NO.	SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.
		Parts Shown in Fig. 30 (continued)	
30 -78 **	S1	Lever Switch, SOURCE	080-004-9-002
-79	S2	Lever Switch, COUPLING	080-003-9-002
-80 *	VR1/S3/S4	Variable Resistor with Switches, 5 kΩ, LEVEL/SLOPE	008-406-9-009
-80 **	VR1/S4	Variable Resistor with Switch, 5 kΩ, LEVEL/SLOPE	008-434-9-006
-81		B Trigger Switch Assy	523-471-9-001
-82	S1	Lever Switch, SOURCE	080-004-9-002
-82 *	S2	Lever Switch, COUPLING	080-004-9-002
-83 *	VR1/S3/S4	Variable Resistor with Switches, 5 kΩ, LEVEL/SLOPE	008-406-9-021
-83 **	VR1/S3	Variable Resistor with Switch, 5 kΩ, LEVEL/SLOPE	008-434-9-008
-84 *		Horizontal Mode Control Assy	523-511-9-001
-84 **		Horizontal Mode Control Assy	523-472-9-001
-85		Interconnect Printed Circuit Board (Hor. Display)	302-552-9-001
-86		Knob, Pushbutton (MODE)	751-207-9-009
-87	S10-19	Switch Contact, Pushbutton	088-069-9-002
-88		Post, Hex	634-147-9-001
-89		Hex Nut, M3	653-068-9-001
-90		Hex Nut, M6	653-027-9-002
-91		Nut, Knurled	653-046-9-001
-92		Nut, Knurled	653-068-9-003
-93		Lock Washer, M2.6	731-068-9-002
-94		Lock Washer, M3	731-068-9-003
-95		Lock Washer, M3	731-063-9-001
-96 *		Washer, Insulator	731-068-9-004
-97		Flat Washer	731-059-9-001
-98		Flat Washer	731-060-9-001
-99		Pan Head Screw, M2.6 x 8	634-147-9-005
-100		Pan Head Screw, M3 x 6	634-054-9-010
-101		Pan Head Screw, M3 x 8	634-123-9-004
-102		Flat Head Screw, M2.6 x 6	634-147-9-005
-103		Flat Head Screw, M3 x 6	634-054-9-009
-104		Self Tapping Screw, 3 x 6	710-051-9-001
-105		Self Tapping Screw, 3 x 8	710-064-9-001
-106		Self Tapping Screw, 3 x 10	710-052-9-001
-107		Self Tapping Flat Head Screw, 3 x 18	634-147-9-008
-108		Screw, Plastic, M3 x 6	634-072-9-001

* = Used only in Model 1590
** = Used only in Model 1570

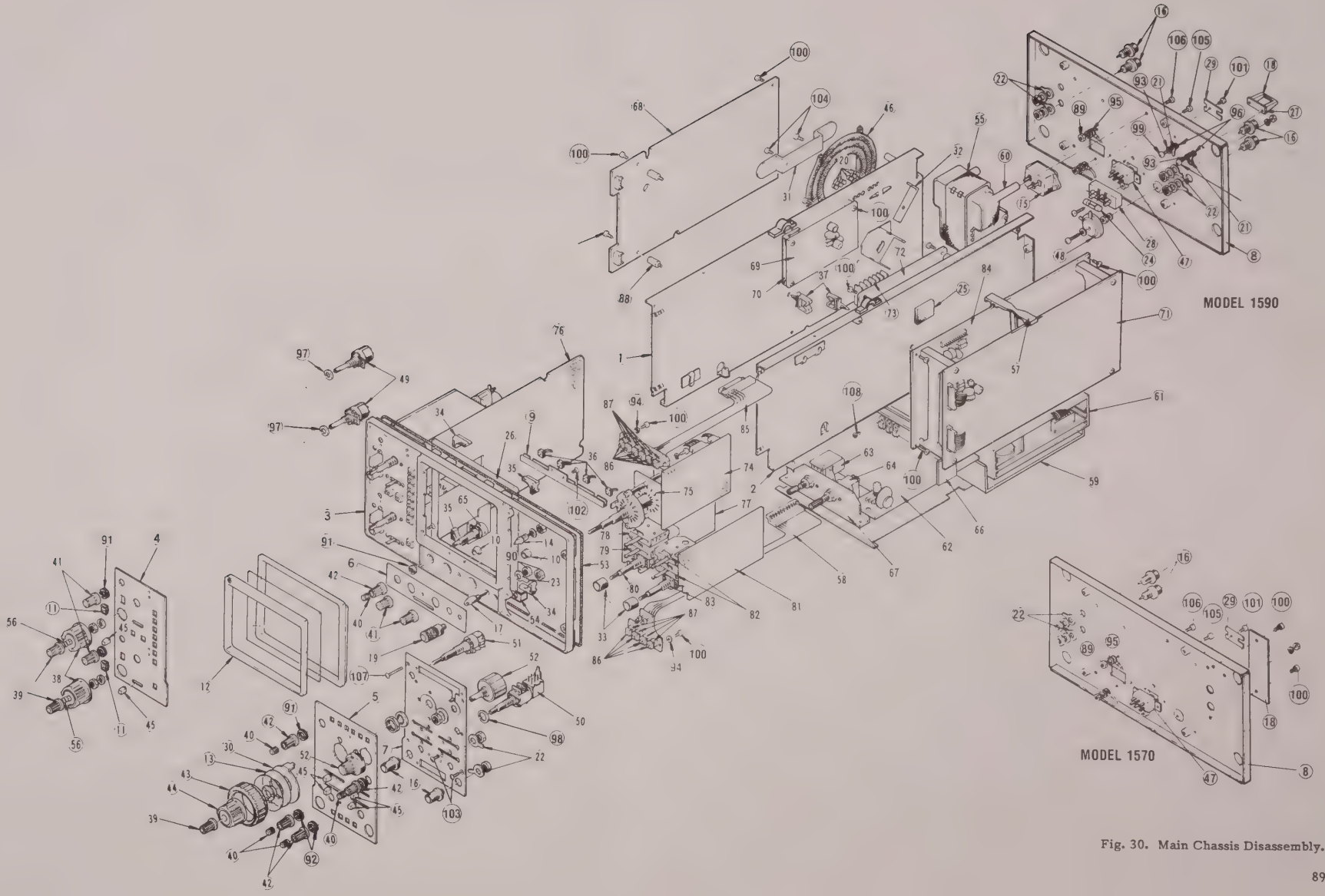


Fig. 30. Main Chassis Disassembly.

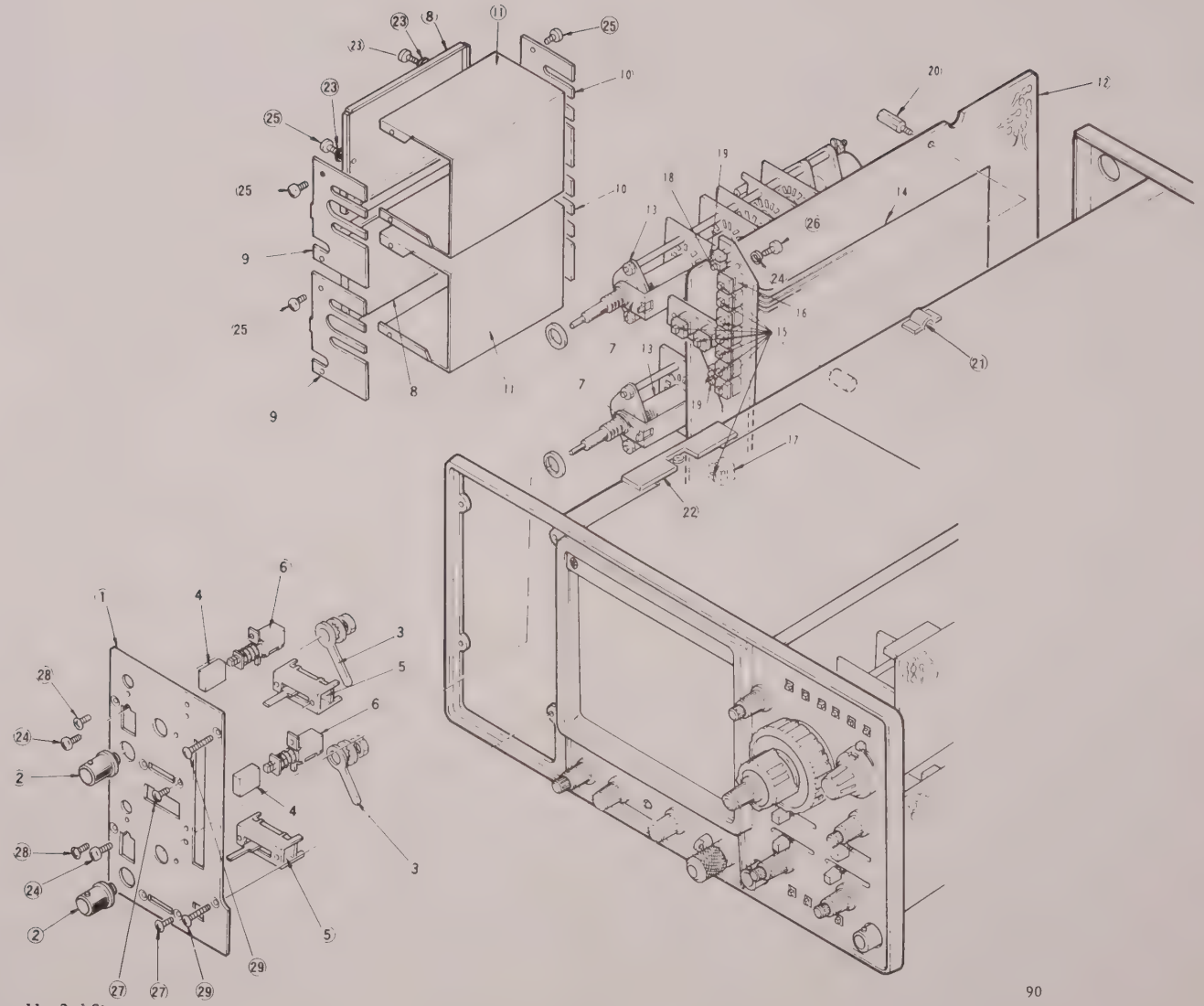


Fig. 31. Main Chassis Disassembly, 2nd Stage.

INDEX NO.	SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.
		Parts Shown in Fig. 31	
31 -1 *		Sub Panel	254-051-9-001
-1 **		Sub Panel	254-065-9-001
-2		Receptacle, BNC	773-090-9-001
-3		Ground Lug	740-032-9-004
-4 *		Pushbutton Knob (PUSH 50Ω)	751-207-9-008
-5	S25, S26	Slide Switch, 3-Position, AC-GND-DC	084-097-9-001
-6 *		Pushbutton Switch (PUSH 50Ω)	088-069-9-001
-7		Ground Terminal	740-032-9-004
-8		Shield Case	256-148-9-001
-9		Shield Case	256-149-9-001
-10		Shield Case	256-150-9-001
-11		Shield Case	256-151-9-001
-12		Vertical Attenuator Assy	523-466-9-001
-13	S1/S3/VR3	Rotary Switch	083-286-9-001
	S2/S4/VR4	Rotary Switch	083-286-9-001
-14		Interconnect Printed Circuit Board (Vert. Mode)	302-551-9-001
-15		Knob, Pushbutton (MODE)	751-207-9-009
-16	S1-9	Switch Contact (MODE)	088-069-9-002
-17 *	S20	Switch Contact (BEAM FINDER)	088-069-9-003
-18 *	D1, 6, 7	LED (UNCAL)	158-039-9-001
-19 *	D4, 5	LED (X5 GAIN)	158-039-9-002
-20		Hex Post	634-147-9-001
-21		Grounding Plate	740-035-9-001
-22		Cushion	763-183-9-003
-23		Lock Washer, M2.6	731-068-9-002
-24		Lock Washer, M3	731-068-9-003
-25		Pan Head Screw, M2.6 x 4	634-147-9-006
-26		Pan Head Screw, M3 x 6	634-054-9-010
-27		Flat Head Screw, M2 x 4	634-147-9-007
-28		Flat Head Screw, M3 x 6	634-054-9-009
-29		Self Tapping Flat Head Screw, M3 x 18	634-147-9-008

* = Used only in Model 1590
** = Used only in Model 1570

INDEX NO.	SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.
		Parts Shown in Fig. 32	
32 -1 *		CRT Socket	749-088-9-001
-1 **		CRT Socket	749-080-9-001
-2		Lead Wire with Connector, 1 pin	527-084-9-016
-3 *		CRT Shield	256-144-9-001
-3 **		CRT Shield	256-163-9-002
-4 *		CRT Shield	256-146-9-001
-4 **		CRT Shield	256-163-9-001
-5 *		CRT Shield	256-147-9-001
-6		Reflector Sheet	261-156-9-001
-7		Reflector Sheet	261-158-9-001
-8		CRT Band	741-143-9-002
-9		CRT Mounting, LH	251-508-9-001
-10		CRT Mounting, RH	251-509-9-001
-11 *		CRT, 150ATM31A	230-021-9-001
-11 **		CRT, 150CTM31	230-022-9-001
-12		Trace Rotation Coil	041-133-9-007
-13 *		Y Axis (Perpendicularity) Coil	041-133-9-002
-14		Lock Washer, M4	724-038-9-001
-15		Lock Washer, M3	731-068-9-003
-16		Pan Head Screw, M3 x 35	634-147-9-009
-17		Pan Head Screw, M4 x 8	634-055-9-001
-18		Self Tapping Screw, M3 x 6	710-051-9-001
-19		Self Tapping Screw, M3 x 10	710-052-9-001
-20		Cushion	763-183-9-003
-21 **		Cable Retainer	763-183-9-002

* = Used only in Model 1590
** = Used only in Model 1570

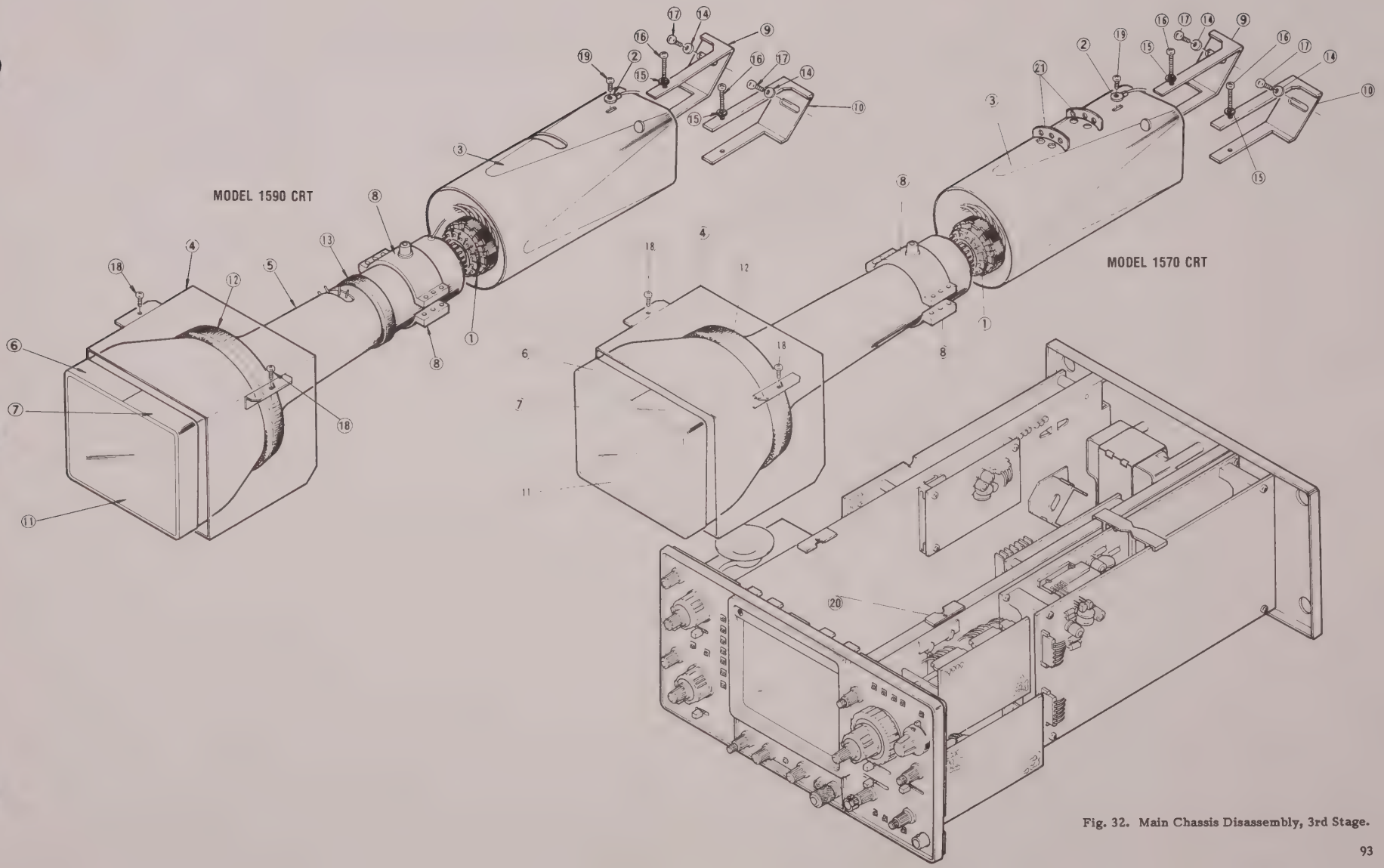


Fig. 32. Main Chassis Disassembly, 3rd Stage.

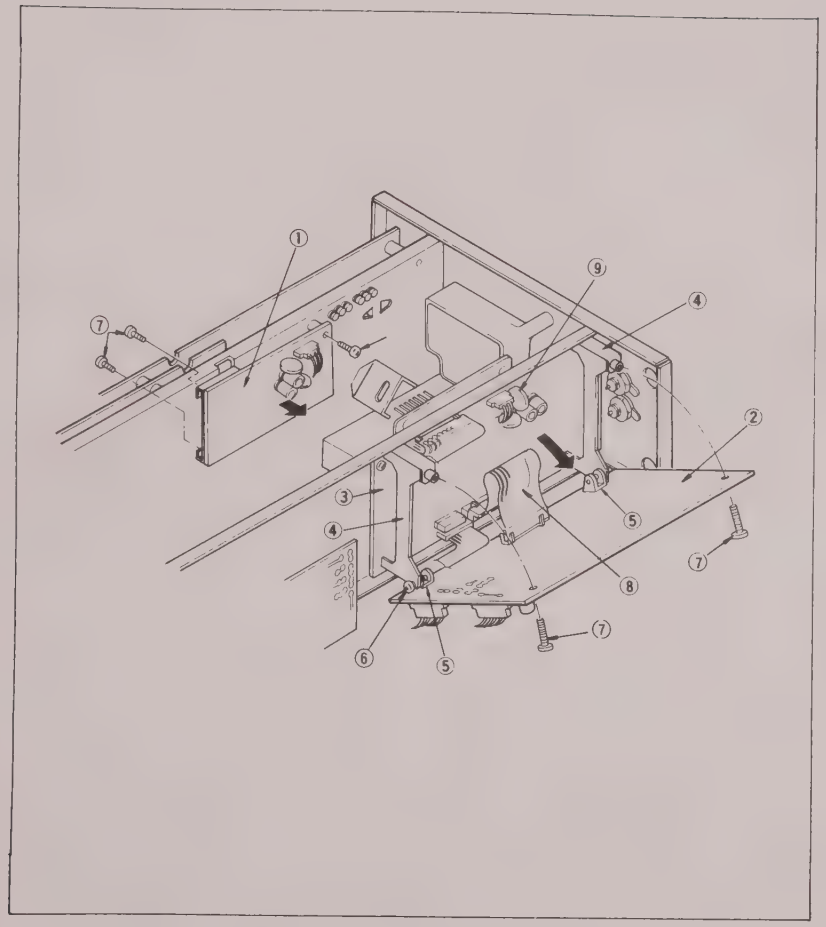


Fig. 33. Vertical Output, Trigger & Sweep, and Horizontal Mode Control Assemblies.

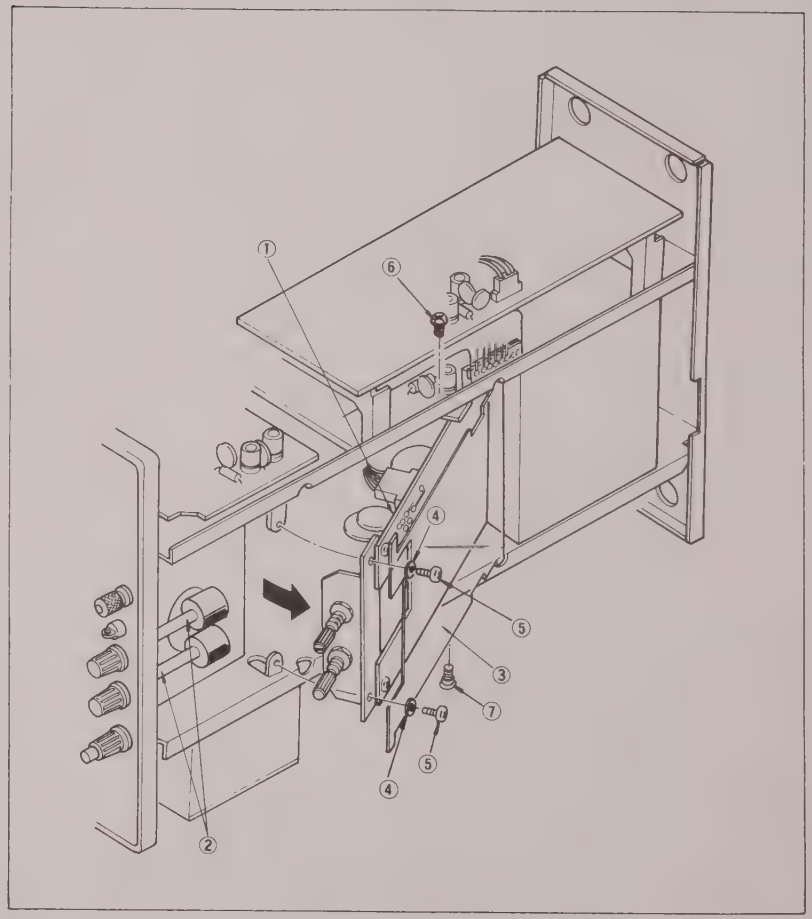


Fig. 34. Power Supply & Blanking Assembly.

INDEX NO.	SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.
		Parts Shown in Fig. 33	
33 -1		Vertical Output Amplifier Assy	523-468-9-001
-2		Trigger & Sweep Assy	523-489-9-001
-3 *		Horizontal Mode Control Assy	523-511-9-001
-3 **		Horizontal Mode Control Assy	523-472-9-001
-4		Bracket	251-513-9-001
-5		Bracket	251-557-9-001
-6		Hinge Pin (Nylon Rivet)	381-107-9-001
-7		Pan Head Screw, M3 x 6	634-054-9-010
-8		Interconnect Printed Circuit Board	302-604-9-001
-9 *		Lithium Battery, 3 V, 140 ohm AH	213-005-9-001
		Parts Shown in Fig. 34	
34 -1		Power Supply & Blanking Assy	523-475-9-001
-2		Extension Shaft	763-166-9-001
-3		Insulator	342-082-9-004
-4		Lock Washer, M3	731-068-9-003
-5		Pan Head Screw, M3 x 8	634-054-9-010
-6		Self Tapping Screw, M3 x 6	710-051-9-001
-7		Screw	634-147-9-002

* = Used only in Model 1590
** = Used only in Model 1570

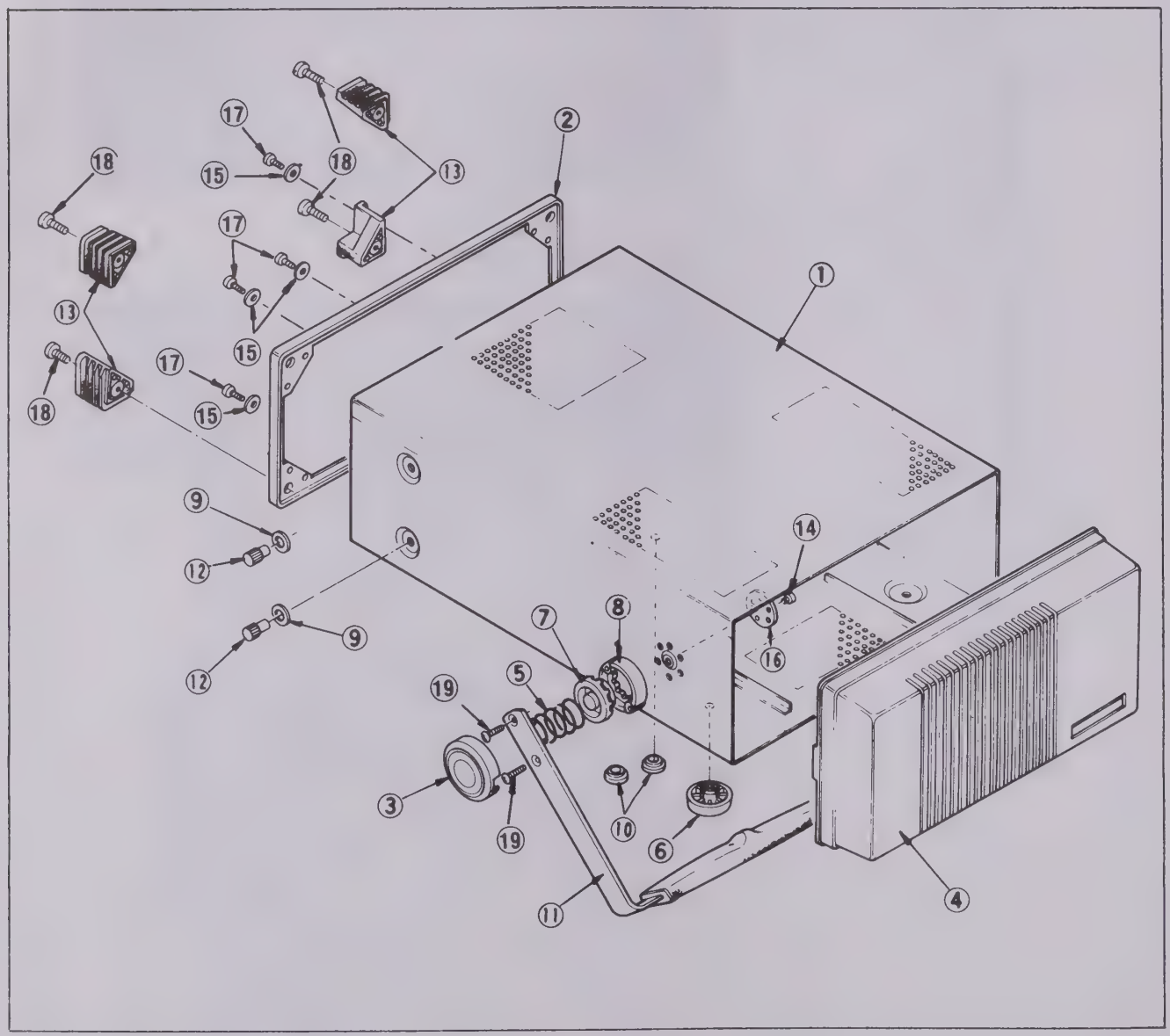


Fig. 35. Oscilloscope Case.

INDEX NO.	SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.
		Parts Shown in Fig. 35	
35 -1		Oscilloscope Case	272-161-9-001
-2		Rear Escutcheon	769-115-9-003
-3		Handle Cover	763-166-9-002
-4		Panel Cover (Optional Accessory)	LC-100
-5		Spring, Handle	767-105-9-001
-6		Rubber Leg	381-100-9-001
-7		Handle Mounting, Outer Gear	251-506-9-001
-8		Handle Mounting, Inner Ring	251-507-9-001
-9		Spacer, CH 3, CH 4 POSITION	759-116-9-001
-10		Bushing, Hole	381-077-9-002
-11		Handle	746-048-9-001
-12		Knob, CH 3, CH 4 POSITION	751-207-9-007
-13		Cord Winder	380-338-9-006
-14		Hex Socket Flat Head Screw	634-147-9-003
-15		Lock Washer, M3	731-063-9-001
-16		Washer	731-068-9-001
-17		Pan Head Screw, M3 x 8	634-123-9-004
-18		Pan Head Screw, M6 x 11	634-157-9-002
-19		Pan Head Screw, M3 x 8	634-157-9-001

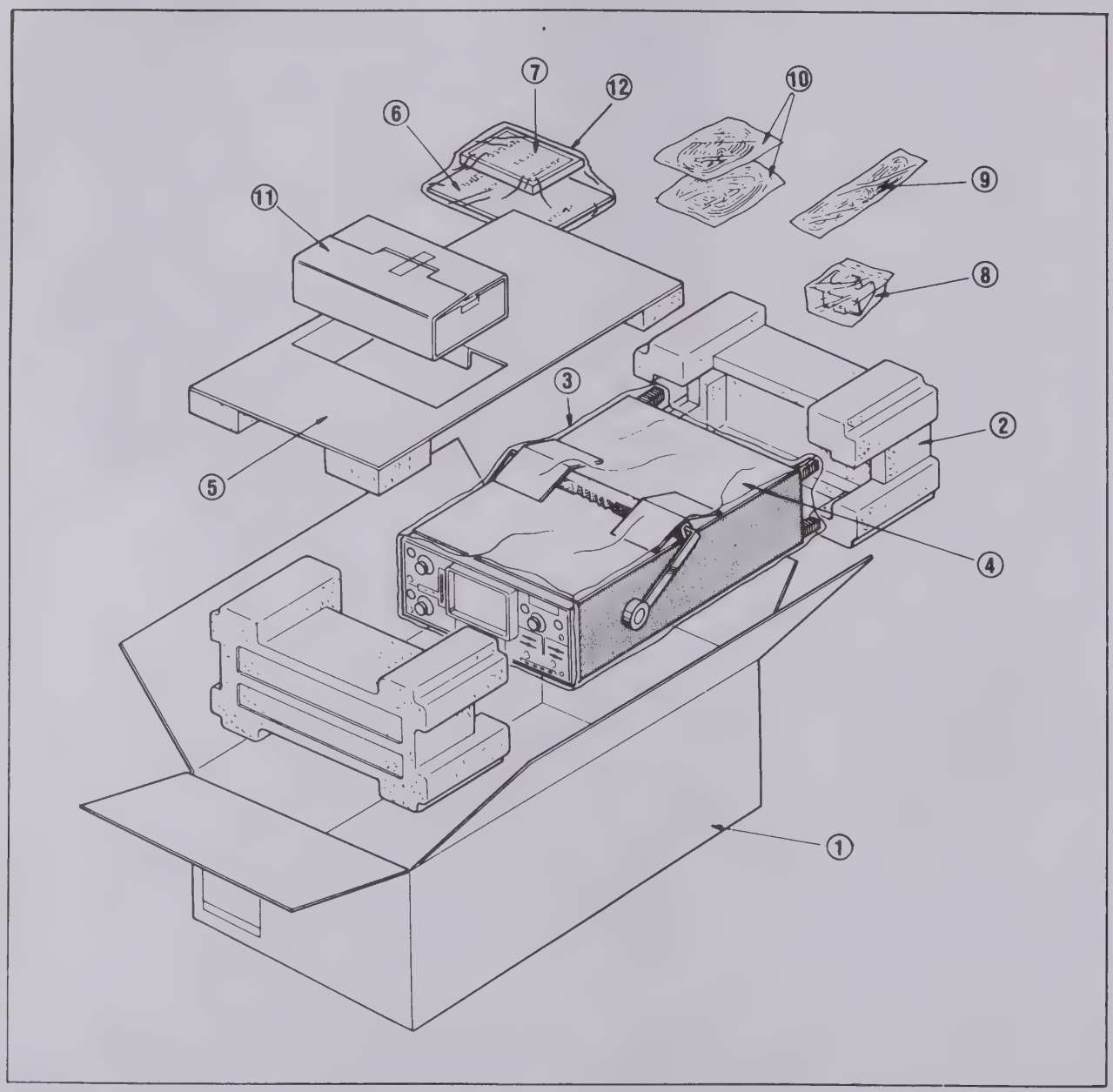


Fig. 36. Packing Drawing.

PACKING PARTS

Parts Shown in Fig. 36

INDEX NO.	SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.
36 -1 *		Carton Box	500-580-9-001
-1 **		Carton Box	500-555-9-001
-2		Pad (Formed Styrene)	502-138-9-001
-3		Polyethylene Bag	502-138-9-002
-4		Protective Cover	502-138-9-003
-5		Pad, Carton	502-138-9-005
-6 *		Composite (Schematic Diagram & Parts List)	499-246-9-001
-6 **		Composite (Schematic Diagram & Parts List)	499-232-9-001
-6 *		Instruction Manual	480-360-9-001
-6 **		Instruction Manual	480-339-9-001
-7		Factory Service List	492-036-0-000
-7		Warranty Card	491-199-9-001
-8		Probe Holder	251-528-9-001
-9		Power Cord (UL/CSA)	420-030-9-001
-10		10:1 Probe (Model PR-45	534-045-9-001
-11		Pad, Carton	502-138-9-004
-12		Polyethylene Bag	502-132-9-001

* = Used only in Model 1590
** = Used only in Model 1570

ELECTRICAL PARTS

CHASSIS ASSEMBLY
(Model 1590 Y70-1280-00)
(Model 1570 Y70-1360-00)

SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART. NO.
	RESISTORS	
	Standard value resistors are not listed. These are readily available from your local parts distributor. See schematic diagram for value. Unless specified otherwise on schematic, such resistors are ±5%, 1/4 W.	
R1*, 2*	50Ω ±1%, 1/2 W Metal Film	013-051-9-001
VR1/S21, VR2/S22	3 kΩ Potentiometer with Push-Pull Switch, V. POSITION and PULL X5 GAIN Control	008-406-9-001
VR3/S27	Dual 5 kΩ Potentiometer with Rotary Switch, HOLDOFF and TRACE SEP Control	008-406-9-003
VR4/S28	Dual 5 kΩ Potentiometer with Push-Pull Switch, H. POSITION and PULL X10 MAG Control	008-406-9-002
VR5	1 kΩ Multi-Turn Precision Potentiometer, DELAY TIME MULTIPLIER Control	008-406-9-004
	CAPACITORS	
C1, 2	.047 µF 630 V Metal Film	033-023-9-001
C3	0.1 µF, 12 V Ceramic	033-018-9-001
C4, 5	4700 pF +100/-0%, 2 kV Ceramic Disc	020-124-9-004
C6	100 pF ±5%, 50 V Ceramic Disc	020-142-9-007
C7	3 pF ±0.25pF, 50 V Ceramic Disc	020-283-9-011
C8, 9	68 pF ±5%, 50 V Ceramic Disc	020-215-9-008
C10	0.1 µF, 600 V Oil Capacitor (use two for 0.2 µF value)	024-009-9-002
	INDICATORS	
D1*	LED (UNCAL)	158-039-9-001
D4-5	LED	158-039-9-002
D6*, 7*	LED (UNCAL)	158-039-9-001
D8	LED, POWER Pilot Light	400-072-9-001
	INDUCTORS	
L1	Trace Rotation Coil	041-133-9-001
L2*	Perpendicularity Coil	041-133-9-002
L3	Delay Line	040-001-9-001
L4, 5	Axial Coil, .22 µH	041-140-9-001
	Ferrite Bead	040-004-9-001
	SWITCHES	
S1-13, 14*, 15-19	Pushbutton Switch, V MODE, H MODE, TRIG MODE	088-069-9-002
S20*	Pushbutton Switch, BEAM FINDER	088-069-9-003
S23*, 24*	Pushbutton Switch, PUSH 50 Ω	088-069-9-001

* = Used only in Model 1590
** = Used only in Model 1570

SCHEMATIC SYMBOL		DESCRIPTION	DYNASCAN PART NO.
S25, 26		3-Position Lever Switch, AC-GND-DC	084-097-9-001
S29		Slide Switch, Line Voltage Select	084-022-9-003
		MISCELLANEOUS	
	*	High Voltage Power Supply Assembly (W02-0402-25)	523-459-9-001
	**	High Voltage Power Supply Assembly (W02-0407-05)	157-022-9-001
		Switching Power Supply Assembly (W02-0405-15)	523-433-9-001
		Fuse, 1.2 A	191-017-9-001
		Fuseholder	742-040-9-001
		Power Thermistor, 4W-25V	005-007-9-001
	*	CRT, 150ATM31A	230-021-9-001
	**	CRT, 150CTM31	230-022-9-001
	*	CRT Socket	749-088-9-001
	**	CRT Socket	749-080-9-001
		BNC Receptacle	773-090-9-001

* = Used only in Model 1590
** = Used only in Model 1570

SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.

VERTICAL ATTENUATOR ASSEMBLY
(Model 1590 X75-1120-00)
(Model 1570 X75-1120-01)

RESISTORS

Standard value resistors are not listed. These are readily available from your local parts distributor. See schematic diagram for value. Unless specified otherwise on schematic, such resistors are ±5%, 1/6 W.

R4	500 kΩ ±1%, 1/4 W Metal Film	013-034-9-018
R5	1 MΩ ±1%, 1/4 W Metal Film	013-008-9-023
R7	750 kΩ ±1%, 1/4 W Metal Film	013-052-9-019
R8	333 kΩ ±1%, 1/4 W	004-193-9-003
R10	900 kΩ ±1%, 1/4 W Metal Film	013-010-9-011
R11	111 kΩ ±1%, 1/4 W Metal Film	013-034-9-036
R20	990 kΩ ±1%, 1/4 W Metal Film	013-010-9-012
R21	10.1 kΩ ±1%, 1/4 W Metal Film	013-034-9-035
R26	1 MΩ ±1%, 1/4 W Metal Film	013-008-9-023
R28, 29	100 Ω ±1%, 1/8 W Metal Film	013-052-9-040
R32, 33	560 Ω ±1%, 1/8 W Metal Film	013-052-9-032
R34	750 Ω ±1%, 1/8 W Metal Film	013-052-9-017
R35	330 Ω ±1%, 1/8 W Metal Film	013-052-9-016
R46	500 kΩ ±1%, 1/4 W Metal Film	013-034-9-018
R47	1 MΩ ±1%, 1/4 W Metal Film	013-008-9-023
R49	750 kΩ ±1%, 1/4 W Metal Film	013-052-9-019
R50	333 kΩ ±1%, 1/4 W	004-193-9-003
R52	900 kΩ ±1%, 1/4 W Metal Film	013-010-9-011
R53	111 kΩ ±1%, 1/4 W Metal Film	013-034-9-036
R62	990 kΩ ±1%, 1/4 W Metal Film	013-010-9-012
R63	10.1 kΩ ±1%, 1/4 W Metal Film	013-034-9-035
R68	1 MΩ ±1%, 1/4 W Metal Film	013-008-9-023
R70, 71	100 Ω ±1%, 1/8 W Metal Film	013-052-9-040
R74, 75	560 Ω ±1%, 1/8 W Metal Film	013-052-9-032
R76	750 Ω ±1%, 1/8 W Metal Film	013-052-9-017
R77	330 Ω ±1%, 1/8 W Metal Film	013-052-9-016
R125, 128	100 Ω ±1%, 1/8 W Metal Film	013-052-9-040
R133, 134	47 Ω ±1%, 1/8 W Metal Film	013-052-9-035
R136, 138	47 Ω ±1%, 1/8 W Metal Film	013-052-9-035
VR1, 2	100 Ω Trimpot	008-434-9-002

CAPACITORS

C1-3	47 pF ±5%, 50 V Ceramic Disc	020-149-9-006
C4	10 pF ±0.5 pF, 100 V Mica	023-064-9-002
C5	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C6	220 pF ±5%, 100 V Mica	023-059-9-002
C8	.01 µF, 630 V Metal Film	033-023-9-002
C9, 10	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C11	33 µF ±20%, 16 V Electrolytic	022-226-9-008
C12, 13	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C14	100 µF ±20%, 25 V Electrolytic	022-226-9-002
C15	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001

* = Used only in Model 1590
** = Used only in Model 1570

SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.
C16	100 µF ±20%, 25 V Electrolytic	022-226-9-002
C17	10 pF ±0.5pF, 50 V Ceramic Disc	020-215-9-001
C18, 19	47 pF ±5%, 50 V Ceramic Disc	020-149-9-006
C21	10 pF ±0.5 pF, 100 V Mica	023-064-9-002
C22	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C23	220 pF ±5%, 100 V Mica	023-059-9-002
C24	39 pF ±5%, 50 V Ceramic Disc	020-171-9-006
C25	.01 µF, 630 V Metal Film	033-023-9-002
C26	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C27	33 pF ±5%, 50 V Ceramic Disc	020-238-9-001
C28	33 µF ±20%, 16 V Electrolytic	022-226-9-008
C29	15 pF ±5%, 50 V Ceramic Disc	020-171-9-002
C30	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C31, 32	100 µF ±20%, 25 V Electrolytic	022-226-9-002
C33, 34	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C35	10 pF ±0.5pF, 50 V Ceramic Disc	020-215-9-001
C36-44	100 pF ±5%, 50 V Ceramic Disc	020-142-9-007
C45, 46	2200 pF ±10%, 50 V Ceramic Disc	020-296-9-004
C47	4700 pF ±10%, 50 V Ceramic Disc	020-302-9-001
C48	100 pF ±5%, 50 V Ceramic Disc	020-142-9-007
C49	15 pF ±5%, 50 V Ceramic Disc	020-171-9-002
C51	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C52	1000 pF ±10%, 50 V Ceramic Disc	020-249-9-001
C53	47 pF ±5%, 50 V Ceramic Disc	020-149-9-006
C54	8 pF ±0.5 pF, 50 V Ceramic Disc	020-302-9-002
C55	1000 pF ±10%, 50 V Ceramic Disc	020-249-9-001
C56	1 pF ±0.25 pF, 50 V Ceramic Disc	020-142-9-001
C57	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C58	33 pF ±5%, 50 V Ceramic Disc	020-238-9-001
C61	8 pF ±0.5 pF, 50 V Ceramic Disc	020-302-9-002
C62	39 pF ±5%, 50 V Ceramic Disc	020-171-9-006
C63	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C64	1 pF ±0.25 pF, 50 V Ceramic Disc	020-142-9-001
C65	33 µF ±20%, 16 V Electrolytic	022-226-9-008
C67	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C68	100 pF ±5%, 50 V Ceramic Disc	020-142-9-007
C69	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C70	100 pF ±5%, 50 V Ceramic Disc	020-142-9-007
C71, 72	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C73	33 µF ±20%, 16 V Electrolytic	022-226-9-008
C74, 75	2 pF ±0.25 pF, 50 V Ceramic Disc	020-234-9-003
C76, 77, 82, 83	3 pF ±0.25 pF, 50 V Ceramic Disc	020-223-9-001
TC1-4	20 pF Trimmer	028-057-9-001
TC5, 6	6 pF Trimmer	028-065-9-003
TC7	40 pF Trimmer	028-069-9-001
TC8	20 pF Trimmer	028-057-9-001
TC10	6 pF Trimmer	028-065-9-003
TC11-15	20 pF Trimmer	028-057-9-001
TC16, 17	6 pF Trimmer	028-065-9-003

* = Used only in Model 1590
** = Used only in Model 1570

SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.
TC18	40 pF Trimmer	028-069-9-001
TC19	20 pF Trimmer	028-057-9-001
TC21	6 pF Trimmer	028-065-9-003
TC22	20 pF Trimmer	028-057-9-001
TC23, 24	6 pF Trimmer	028-065-9-003
	DIODES AND TRANSISTORS	
D1-4	1S1544A, Silicon Diode	151-096-9-001
D5-11	DS442X, Silicon Switching Diode	151-097-9-001
D12-15	WZ-120, 12 V Zener Diode	152-110-9-001
Q1, 2	DN1901, Dual FET	182-070-9-001
	INTEGRATED CIRCUITS	
IC1, 2	MC14584BCP, CMOS IC	307-259-9-007
IC3	MC14001BCP, CMOS IC	307-259-9-001
IC4	MC14027BCP, CMOS IC	307-259-9-016
IC5	SN7404N, Digital IC	307-259-9-014
IC6	MC14174BCP, CMOS IC	307-259-9-005
IC7	MC14081BCP, CMOS IC	307-259-9-017
IC8	MC14503BCP, CMOS IC	307-259-9-006
IC9	SN7432N, Digital IC	307-259-9-015
IC10	MC14027BCP, CMOS IC	307-259-9-016
IC11	MC14503BCP, CMOS IC	307-259-9-006
IC12, 13	ATM-4020, Custom Linear IC	307-309-9-001
	MISCELLANEOUS	
L1-4	10 μH Ferri-Inductor	041-133-9-006
S1/S3/VR3	Rotary Switch, VOLTS/DIV	083-286-9-001
S2/S4/VR4	Rotary Switch, VOLTS/DIV	083-286-9-001

* = Used only in Model 1590
** = Used only in Model 1570

SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.

VERTICAL PREAMP ASSEMBLY
(Model 1590 X73-1320-00)
(Model 1570 X73-1320-01)

RESISTORS

Standard value resistors are not listed. These are readily available from your local parts distributor. See schematic diagram for value. Unless specified otherwise on schematic, such resistors are ±5%, 1/8 W.

R3*	100 Ω ±1%, 1/8 W Metal Film	013-052-9-040
R3**	150 Ω ±1%, 1/8 W Metal Film	013-052-9-031
R6, 8	270 Ω ±1%, 1/8 W Metal Film	013-052-9-021
R13	3 kΩ ±1%, 1/8 W Metal Film	013-052-9-023
R14	1.8 kΩ ±1%, 1/8 W Metal Film	013-052-9-044
R15	300 Ω ±1%, 1/8 W Metal Film	013-052-9-039
R16, 17	750 Ω ±1%, 1/8 W Metal Film	013-052-9-017
R18, 19	5.6 kΩ ±1%, 1/8 W Metal Film	013-052-9-004
R20, 21	3.6 kΩ ±1%, 1/8 W Metal Film	013-053-9-002
R22, 23	1.5 kΩ ±1%, 1/8 W Metal Film	013-052-9-022
R27, 28	470 Ω ±1%, 1/8 W Metal Film	013-052-9-027
R29	51 Ω ±1%, 1/8 W Metal Film	013-052-9-036
R35	47 Ω ±1%, 1/8 W Metal Film	013-052-9-035
R36, 37	430 Ω ±1%, 1/8 W Metal Film	013-052-9-041
R40*	180 Ω ±1%, 1/8 W Metal Film	013-064-9-001
R40**	150 Ω ±1%, 1/8 W Metal Film	013-052-9-031
R41, 42	430 Ω ±1%, 1/8 W Metal Film	013-052-9-041
R46	150 Ω ±1%, 1/8 W Metal Film	013-052-9-031
R50, 51	910 Ω ±1%, 1/8 W Metal Film	013-052-9-042
R54*	240 Ω ±1%, 1/8 W Metal Film	013-052-9-037
R54**	300 Ω ±1%, 1/8 W Metal Film	013-052-9-039
R56, 57	180 Ω ±1%, 1/8 W Metal Film	013-064-9-001
R59	360 Ω ±1%, 1/8 W Metal Film	013-052-9-011
R60-61*	2.2 kΩ ±1%, 1/8 W Metal Film	013-052-9-028
R60-61**	470 Ω ±1%, 1/8 W Metal Film	013-052-9-027
R62	1.8 kΩ ±1%, 1/8 W Metal Film	013-052-9-044
R67-68*	2.2 kΩ ±1%, 1/8 W Metal Film	013-052-9-028
R67-68**	470 Ω ±1%, 1/8 W Metal Film	013-052-9-027
R69	360 Ω ±1%, 1/8 W Metal Film	013-052-9-011
R70	1.6 kΩ ±1%, 1/8 W Metal Film	013-052-9-033
R99	360 Ω ±1%, 1/8 W Metal Film	013-052-9-011
R100*	2 kΩ ±1%, 1/8 W Metal Film	013-052-9-018
R100**	470 Ω ±1%, 1/8 W Metal Film	013-052-9-027
R101*	2.2 kΩ ±1%, 1/8 W Metal Film	013-052-9-028
R101**	470 Ω ±1%, 1/8 W Metal Film	013-052-9-027
R102	1.8 kΩ ±1%, 1/8 W Metal Film	013-052-9-044
R107, 108	180 Ω ±1%, 1/8 W Metal Film	013-064-9-001
R110	1 kΩ ±1%, 1/8 W Metal Film	013-052-9-043
R113, 114	750 Ω ±1%, 1/8 W Metal Film	013-052-9-017
R118*	220 Ω ±1%, 1/8 W Metal Film	013-052-9-020
R118**	240 Ω ±1%, 1/8 W Metal Film	013-052-9-037
R133-136	430 Ω ±1%, 1/8 W Metal Film	013-052-9-041

* = Used only in Model 1590
** = Used only in Model 1570

SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.
R137, 138	180 Ω ±1%, 1/8 W Metal Film	013-064-9-001
R140*	470 Ω ±1%, 1/8 W Metal Film	013-052-9-027
R140**	390 Ω ±1%, 1/8 W Metal Film	013-065-9-001
R141	360 Ω ±1%, 1/8 W Metal Film	013-052-9-011
R142-143*	2.2 kΩ ±1%, 1/8 W Metal Film	013-052-9-028
R142-143**	470 Ω ±1%, 1/8 W Metal Film	013-052-9-027
R144	1.8 kΩ ±1%, 1/8 W Metal Film	013-052-9-044
R151	1.1 kΩ ±1%, 1/8 W Metal Film	013-052-9-047
R152, 153	910 Ω ±1%, 1/8 W Metal Film	013-052-9-042
R154	1.1 kΩ ±1%, 1/8 W Metal Film	013-052-9-047
R155, 156	330 Ω ±1%, 1/8 W Metal Film	013-052-9-016
R157	1 kΩ ±1%, 1/8 W Metal Film	013-052-9-043
R158	220 Ω ±1%, 1/8 W Metal Film	013-052-9-020
R159	1 kΩ ±1%, 1/8 W Metal Film	013-052-9-043
R160, 161	750 Ω ±1%, 1/8 W Metal Film	013-052-9-017
R166*	100 Ω ±1%, 1/8 W Metal Film	013-052-9-040
R166**	150 Ω ±1%, 1/8 W Metal Film	013-052-9-031
R169, 170	270 Ω ±1%, 1/8 W Metal Film	013-052-9-021
R171	1.8 kΩ ±1%, 1/8 W Metal Film	013-052-9-044
R172	5.6 kΩ ±1%, 1/8 W Metal Film	013-052-9-004
R173	1.8 kΩ ±1%, 1/8 W Metal Film	013-052-9-044
R174	5.1 kΩ ±1%, 1/8 W Metal Film	013-052-9-003
R175	300 Ω ±1%, 1/8 W Metal Film	013-052-9-039
R177	2.2 kΩ ±1%, 1/8 W Metal Film	013-052-9-028
R178	6.8 kΩ ±1%, 1/8 W Metal Film	013-052-9-025
R179	2.2 kΩ ±1%, 1/8 W Metal Film	013-052-9-028
R189, 190	750 Ω ±1%, 1/8 W Metal Film	013-052-9-017
R191, 192	5.6 kΩ ±1%, 1/8 W Metal Film	013-052-9-004
R193, 194	3.6 kΩ ±1%, 1/8 W Metal Film	013-053-9-002
R195, 196	1.5 kΩ ±1%, 1/8 W Metal Film	013-052-9-022
R200, 201	470 Ω ±1%, 1/8 W Metal Film	013-052-9-027
R202	51 Ω ±1%, 1/8 W Metal Film	013-052-9-036
R208	47 Ω ±1%, 1/8 W Metal Film	013-052-9-035
R209, 210	430 Ω ±1%, 1/8 W Metal Film	013-052-9-041
R213*	180 Ω ±1%, 1/8 W Metal Film	013-064-9-001
R213**	150 Ω ±1%, 1/8 W Metal Film	013-052-9-031
R214, 215	430 Ω ±1%, 1/8 W Metal Film	013-052-9-041
R219	150 Ω ±1%, 1/8 W Metal Film	013-052-9-031
R223, 224	910 Ω ±1%, 1/8 W Metal Film	013-052-9-042
R227	200 Ω ±1%. 1/8 W Metal Film	013-075-9-001
R229, 230	180 Ω ±1%, 1/8 W Metal Film	013-064-9-001
R231	360 Ω ±1%, 1/8 W Metal Film	013-052-9-011
R232-233*	2.2 kΩ ±1%, 1/8 W Metal Film	013-052-9-028
R232-233**	470 Ω ±1%, 1/8 W Metal Film	013-052-9-027
R234	1.8 kΩ ±1%, 1/8 W Metal Film	013-052-9-044
R261	360 Ω ±1%, 1/8 W Metal Film	013-052-9-011
R262*	2 kΩ ±1%, 1/8 W Metal Film	013-052-9-018
R262**	470 Ω ±1%, 1/8 W Metal Film	013-052-9-027
R263*	2.2 kΩ ±1%, 1/8 W Metal Film	013-052-9-028
R263**	470 Ω ±1%, 1/8 W Metal Film	013-052-9-027

* = Used only in Model 1590
** = Used only in Model 1570

SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.
R264	1.8 kΩ ±1%, 1/8 W Metal Film	013-052-9-044
R269, 270	180 Ω ±1%, 1/8 W Metal Film	013-064-9-001
R272	1 kΩ ±1%, 1/8 W Metal Film	013-052-9-043
R275, 276	750 Ω ±1%, 1/8 W Metal Film	013-052-9-017
R280*	220 Ω ±1%, 1/8 W Metal Film	013-052-9-020
R280**	240 Ω ±1%, 1/8 W Metal Film	013-052-9-037
R281, 282	150 Ω ±1%, 1/8 W Metal Film	013-052-9-031
R307, 308	1.5 kΩ ±1%, 1/8 W Metal Film	013-052-9-022
VR1, 2	500 Ω Potentiometer, CH 3 & 4 POSITION	008-406-9-020
VR3-6	100 Ω Trimpot	008-434-9-002
VR7	500 Ω Trimpot	008-434-9-003
VR8	200 Ω Trimpot	008-434-9-001
VR9, 10	500 Ω Trimpot	008-434-9-003
VR11, 13-17	100 Ω Trimpot	008-434-9-002
VR18	200 Ω Trimpot	008-434-9-001
VR19, 20	500 Ω Trimpot	008-434-9-003
VR21	100 Ω Trimpot	008-434-9-002
VR22	500 Ω Trimpot	008-434-9-003
	CAPACITORS	
C1*	15 pF ±5%, 50 V Ceramic Disc	020-171-9-002
C1**	12 pF ±0.5 pF, 50 V Ceramic Disc	020-167-9-002
C2*	22 pF ±5%, 50 V Ceramic Disc	020-215-9-002
C2**	10 pF ±0.5 pF, 50 V Ceramic Disc	020-215-9-001
C3, 4	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C5	3 pF ±0.25 pF, 50 V Ceramic Disc	020-233-9-001
C7, 8	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C9*	12 pF ±0.5 pF, 50 V Ceramic Disc	020-167-9-002
C9**	33 pF ±5%, 50 V Ceramic Disc	020-238-9-001
C11	2200 pF ±10%, 50 V Ceramic Disc	020-296-9-004
C13	27 pF ±5%, 50 V Ceramic Disc	020-215-9-003
C14	22 pF ±5%, 50 V Ceramic Disc	020-215-9-002
C15	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C19	15 pF ±5%, 50 V Ceramic Disc	020-171-9-002
C20	7 pF ±0.5 pF, 50 V Ceramic Disc	020-149-9-001
C21	1000 pF ±10%, 50 V Ceramic Disc	020-249-9-001
C22	22 pF ±5%, 50 V Ceramic Disc	020-215-9-002
C23	68 pF ±5%, 50 V Ceramic Disc	020-144-9-005
C24	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C25, 26	150 pF ±5%, 50 V Ceramic Disc	020-171-9-008
C27	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C28	22 pF ±5%, 50 V Ceramic Disc	020-215-9-002
C31	2 pF ±0.25 pF, 50 V Ceramic Disc	020-234-9-003
C32	5 pF ±5%, 50 V Ceramic Disc	020-233-9-002
C34-35*	15 pF ±5%, 50 V Ceramic Disc	020-171-9-002
C34-35**	10 pF ±0.5 pF, 50 V Ceramic Disc	020-215-9-001
C36, 37	7 pF ±0.5 pF, 50 V Ceramic Disc	020-149-9-001
C38-39*	33 pF ±5%, 50 V Ceramic Disc	020-238-9-001
C38**	27 pF ±5%, 50 V Ceramic Disc	020-215-9-003
C39**	22 pF ±5%, 50 V Ceramic Disc	020-215-9-002

* = Used only in Model 1590
** = Used only in Model 1570

SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.
C40-41, 44-45	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C46*	12 pF ±0.5 pF, 50 V Ceramic Disc	020-167-9-002
C46**	33 pF ±5%, 50 V Ceramic Disc	020-238-9-001
C48	2200 pF ±10%, 50 V Ceramic Disc	020-296-9-004
C50	39 pF ±5%, 50 V Ceramic Disc	020-171-9-006
C51	22 pF ±5%, 50 V Ceramic Disc	020-215-9-002
C52*	12 pF ±0.5 pF, 50 V Ceramic Disc	020-167-9-002
C53	22 pF ±5%, 50 V Ceramic Disc	020-215-9-002
C54-55*	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C56	15 pF ±5%, 50 V Ceramic Disc	020-171-9-002
C57	7 pF ±0.5 pF, 50 V Ceramic Disc	020-149-9-001
C58	1000 pF ±10%, 50 V Ceramic Disc	020-249-9-001
C59	22 pF ±5%, 50 V Ceramic Disc	020-215-9-002
C60	68 pF ±5%, 50 V Ceramic Disc	020-144-9-005
C61, 62	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C63	100 µF ±20%, 16 V Electrolytic	022-225-9-002
C64	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C65	100 µF ±20%, 16 V Electrolytic	022-225-9-002
C66	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C67	100 µF ±20%, 16 V Electrolytic	022-225-9-002
C68	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C69, 70	100 µF ±20%, 16 V Electrolytic	022-225-9-002
C71, 72	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C73	0.1 µF, 12 V Semiconductor Ceramic	033-018-9-001
C74	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C75, 76	100 µF ±20%, 16 V Electrolytic	022-225-9-002
C77	330 µF ±20%, 16 V Electrolytic	022-238-9-001
C78	100 µF ±20%, 16 V Electrolytic	022-225-9-002
C79	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C80	330 µF ±20%, 16 V Electrolytic	022-238-9-001
C81	220 µF ±20%, 16 V Electrolytic	022-226-9-018
C82	470 µF ±20%, 16 V Electrolytic	022-226-9-006
C83	220 µF ±20%, 16 V Electrolytic	022-226-9-018
C84	47 µF ±20%, 16 V Electrolytic	022-226-9-012
C85-87	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C88	100 µF ±20%, 16 V Electrolytic	022-225-9-002
C89, 90	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C91	100 µF ±20%, 16 V Electrolytic	022-225-9-002
C92	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C93	100 µF ±20%, 16 V Electrolytic	022-225-9-002
C94	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C95	1 µF ±20%, 50 V Electrolytic	022-276-9-017
C96, 97	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C98, 99	100 µF ±20%, 16 V Electrolytic	022-225-9-002
C100	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C101	100 µF ±20%, 16 V Electrolytic	022-225-9-002
C103	1 µF ±20%, 50 V Electrolytic	022-276-9-017
C104	100 µF ±20%, 16 V Electrolytic	022-225-9-002
C105	470 µF ±20%, 16 V Electrolytic	022-226-9-006
C106, 107	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001

* = Used only in Model 1590
** = Used only in Model 1570

SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.
C108*	68 pF ±5%, 50 V Ceramic Disc	020-144-9-005
C109	47 µF ±20%, 16 V Electrolytic	022-226-9-012
C110-112	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C115**	33 pF ±5%, 50 V Ceramic Disc	020-238-9-001
C117-119	100 pF ±5%, 50 V Ceramic Disc	020-096-9-006
C120*	15 pF ±5%, 50 V Ceramic Disc	020-171-9-002
C120**	22 pF ±5%, 50 V Ceramic Disc	020-215-9-002
C122, 123	100 pF ±5%, 50 V Ceramic Disc	020-096-9-006
C124	1 µF ±20%, 50 V Electrolytic	022-276-9-017
C125	0.1 µF, 12 V Semiconductor Ceramic	033-018-9-001
C126	100 pF ±5%, 50 V Ceramic Disc	020-096-9-006
C127-130	0.1 µF, 12 V Semiconductor Ceramic	033-018-9-001
C131*, 132	12 pF ±0.5 pF, 50 V Ceramic Disc	020-167-9-002
C135-136, 138	15 pF ±5%, 50 V Ceramic Disc	020-171-9-002
C140, 141	3 pF ±0.25 pF, 50 V Ceramic Disc	020-233-9-001
C143	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C146, 147	3 pF ±0.25 pF, 50 V Ceramic Disc	020-233-9-001
C150	0.1 µF, 12 V Semiconductor Ceramic	033-018-9-001
C151*, 153*	68 pF ±5%, 50 V Ceramic Disc	020-144-9-005
C155*	10 pF ±0.5 pF, 50 V Ceramic Disc	020-215-9-001
C157	68 pF ±5%, 50 V Ceramic Disc	020-144-9-005
C159	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C160, 161	5 pF ±5%, 50 V Ceramic Disc	020-233-9-002
C162	0.1 µF, 12 V Semiconductor Ceramic	033-018-9-001
C163*	68 pF ±5%, 50 V Ceramic Disc	020-144-9-005
C167-172	15 pF ±5%, 50 V Ceramic Disc	020-171-9-002
C174	3 pF ±0.25 pF, 50 V Ceramic Disc	020-233-9-001
C175-176**	3 pF ±0.25 pF, 50 V Ceramic Disc	020-233-9-001
C177**	5 pF ±5%, 50 V Ceramic Disc	020-233-9-002
C178-181**	100 pF ±5%, 50 V Ceramic Disc	020-096-9-006
C182	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C183	100 pF ±5%, 50 V Ceramic Disc	020-096-9-006
C190, 192, 194-201, 203-207	3 pF ±0.25 pF, 50 V Ceramic Disc	020-233-9-001
TC1-11	20 pF Trimmer	028-057-9-001
	DIODES	
D1-6**	DS442X, Silicon Switching Diode	151-097-9-001
D1-10*	DS442X, Silicon Switching Diode	151-097-9-001
D11, 12	WZ-071, 7.1 V Zener Diode	152-075-9-001
D13-35	DS442X, Silicon Switching Diode	151-097-9-001
D36, 37	WZ-061, 6.1 V Zener Diode	152-052-9-002
D40-43	1S2686, Silicon Diode, Variable Capacitance	151-097-9-002
D44	DS442X, Silicon Switching Diode	151-097-9-001
	TRANSISTORS	
Q1	2SC536KNP-F, NPN Silicon Signal Transistor	176-114-9-001
Q2, 3	2SC1215-T or -S, NPN Silicon Signal Transistor	176-114-9-003
Q4-7*	2SA1161, PNP Silicon Signal Transistor	177-048-9-003

* = Used only in Model 1590
** = Used only in Model 1570

SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.
Q4-7**	2SA838C, PNP Silicon Signal Transistor	177-036-9-001
Q8, 9	2SA608KNP-F, PNP Silicon Signal Transistor	177-048-9-001
Q10-13	2SC1215-T or -S, NPN Silicon Signal Transistor	176-114-9-003
Q14*	2SA1161, PNP Silicon Signal Transistor	177-048-9-003
Q14**	2SA838C, PNP Silicon Signal Transistor	177-036-9-001
Q15	2SC2671, NPN Silicon Signal Transistor	176-130-9-001
Q16*	2SA1161, PNP Silicon Signal Transistor	177-048-9-003
Q16**	2SA838C, PNP Silicon Signal Transistor	177-036-9-001
Q17	2SC2671, NPN Silicon Signal Transistor	176-130-9-001
Q18-21*	2SC1215-T or -S, NPN Silicon Signal Transistor	176-114-9-003
Q18-21**	2SC536KNP-F, NPN Silicon Signal Transistor	176-114-9-001
Q23-26*	2SC1215-T or -S, NPN Silicon Signal Transistor	176-114-9-003
Q23-26**	2SC536KNP-F, NPN Silicon Signal Transistor	176-114-9-001
Q27, 28	2SC1215-T or -S, NPN Silicon Signal Transistor	176-114-9-003
Q29*	2SA1161, PNP Silicon Signal Transistor	177-048-9-003
Q29**	2SA838C, PNP Silicon Signal Transistor	177-036-9-001
Q30	2SC2671, NPN Silicon Signal Transistor	176-130-9-001
Q31, 32	2SC1215-T or -S, NPN Silicon Signal Transistor	176-114-9-003
Q33	2SA608KNP-F, PNP Silicon Signal Transistor	177-048-9-001
Q34	2SC536KNP-F, NPN Silicon Signal Transistor	176-114-9-001
Q35, 36	2SC1047-C NPN Silicon Signal Transistor	176-075-9-001
Q37	2SA608KNP-F, PNP Silicon Signal Transistor	177-048-9-001
Q38, 39	2SC1215-T or -S, NPN Silicon Signal Transistor	176-114-9-003
Q40*	2SA1161, PNP Silicon Signal Transistor	177-048-9-003
Q40**	2SA838C, PNP Silicon Signal Transistor	177-036-9-001
Q41	2SC2671, NPN Silicon Signal Transistor	176-130-9-001
Q42, 43	2SC1215-T or -S, NPN Silicon Signal Transistor	176-114-9-003
Q44, 45	2SA1161, PNP Silicon Signal Transistor	177-048-9-003
Q46-49	2SC536KNP-F, NPN Silicon Signal Transistor	176-114-9-001
Q50, 51	2SC1215-T or -S, NPN Silicon Signal Transistor	176-114-9-003
Q52-55*	2SA1161, PNP Silicon Signal Transistor	177-048-9-003
Q52-55**	2SA838C, PNP Silicon Signal Transistor	177-036-9-001
Q56, 57	2SA608KNP-F, PNP Silicon Signal Transistor	177-048-9-001
Q58-61	2SC1215-T or -S, NPN Silicon Signal Transistor	176-114-9-003
Q62*	2SA1161, PNP Silicon Signal Transistor	177-048-9-003
Q62**	2SA838C, PNP Silicon Signal Transistor	177-036-9-001
Q63	2SC2671, NPN Silicon Signal Transistor	176-130-9-001
Q64-71*	2SC1215-T or -S, NPN Silicon Signal Transistor	176-114-9-003
Q64-71**	2SC536KNP-F, NPN Silicon Signal Transistor	176-114-9-001
Q72, 73	2SC1215-T or -S, NPN Silicon Signal Transistor	176-114-9-003
Q74*	2SA1161, PNP Silicon Signal Transistor	177-048-9-003
Q74**	2SA838C, PNP Silicon Signal Transistor	177-036-9-001
Q75	2SC2671, NPN Silicon Signal Transistor	176-130-9-001
Q76, 77	2SC1215-T or -S, NPN Silicon Signal Transistor	176-114-9-003
Q78, 79	2SC536KNP-F, NPN Silicon Signal Transistor	176-114-9-001
	INTEGRATED CIRCUITS	
IC1, 2	CA3102E, Linear IC	307-259-9-018
IC3	SN74LS32N, Digital IC	307-259-9-024
IC4	SN74LS11N, Digital IC	307-259-9-023

* = Used only in Model 1590
** = Used only in Model 1570

SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.
IC5	SN74LS112AN, Digital IC	307-259-9-025
IC6	SN74LS08N, Digital IC	307-259-9-010
IC7	SN74LS00N, Digital IC	307-139-9-002
	MISCELLANEOUS	
L1-3, 6-9, 11	22 µH Ferri-Inductor	041-068-9-004
L12*	0.68 µH Ferri-Inductor	041-133-9-008
	Ferrite Core, Bead Type	040-004-9-002
TH1	Thermistor, SDT-1000	005-003-9-002

* = Used only in Model 1590
** = Used only in Model 1570

SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.

VERTICAL OUTPUT AMPLIFIER ASSEMBLY

(Model 1590 X73-1330-00
(Model 1570 X73-1330-01)

RESISTORS

Standard value resistors are not listed. These are readily available from your local parts distributor. See schematic diagram for value. Unless specified otherwise on schematic, such resistors are ±5%, 1/8 W.

R1, 2	91 Ω ±1%, 1/8 W Metal Film	013-052-9-049
R8, 9	27 Ω ±1%, 1/8 W Metal Film	013-052-9-048
R16, 17	620 Ω ±1%, 1/4 W Metal Film	013-064-9-002
R29	82 Ω ±5%, 2W Metal Film	013-054-9-001
R40, 41	150 Ω ±5%, 2W Metal Film	013-054-9-002
R43	5.6 kΩ ±1%, 1/8 W Metal Film	013-052-9-004
R44	4.3 kΩ ±1%, 1/8 W Metal Film	013-052-9-051
R45	150 Ω ±1%, 1/8 W Metal Film	013-052-9-031
R46, 47	150 Ω ±5%, 2W Metal Film	013-054-9-002
R49	330 Ω ±1%, 1/8 W Metal Film	013-052-9-016
VR1	100 Ω Trimpot	008-434-9-004

CAPACITORS

C1	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C3	1000 µF ±20%, 6.3 V Electrolytic	022-226-9-019
C4-8	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C9	4700 pF ±10%, 500 V Ceramic Disc	020-302-9-003
C10*, 11	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C12	33 µF ±20%, 63 V Electrolytic	022-226-9-005
C13	4700 pF ±10%, 500 V Ceramic Disc	020-302-9-003
C14	47 µF ±20%, 35 V Electrolytic	022-226-9-004
C15	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C16	47 µF ±20%, 16 V Electrolytic	022-226-9-012
C17	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C18	7 pF ±0.25 pF, 50 V Ceramic Disc	020-142-9-002
C19	1500 pF ±10%, 50 V Ceramic Disc	020-296-9-003
C20	10 pF ±0.5 pF, 50 V Ceramic Disc	020-215-9-001
C21	330 µF ±20%, 16 V Electrolytic	022-238-9-001
TC1	10 pF Trimmer	028-065-9-002
TC3	40 pF Trimmer	028-065-9-005

TRANSISTORS

Q1-4	2SC2499, NPN Silicon Signal Transistor	176-114-9-006
Q5	2SC1047-C, NPN Silicon Signal Transistor	176-075-9-001
Q7, 8	2SC2644, NPN Silicon Signal Transistor	176-114-9-008
Q9, 10	2SC1164-O, NPN Silicon Signal Transistor	176-114-9-007
Q11, 12*	2SC536KNP-F, NPN Silicon Signal Transistor	176-114-9-001
Q13, 14	2SC2644, NPN Silicon Signal Transistor	176-114-9-008

MISCELLANEOUS

L1-4, 5*, 6*	0.22 µH Ferri-Inductor	041-133-9-009
L7-9	100 µH Ferri-Inductor	041-124-9-001
	Ferrite Core, Bead Type	040-004-9-002

* = Used only in Model 1590
** = Used only in Model 1570

SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.

SWEEP ROTARY SWITCH ASSEMBLY
(Model 1590 X74-1310-00)
(Model 1570 X74-1310-01)

RESISTORS

Standard value resistors are not listed. These are readily available from your local parts distributor. See schematic diagram for value. Unless specified otherwise on schematic, such resistors are ±5%, 1/6 W.

R1	360 kΩ ±1%, 1/8 W Metal Film	013-051-9-002
R2	120 kΩ ±1%, 1/8 W Metal Film	013-053-9-005
R3, 4	30 kΩ ±1%, 1/8 W Metal Film	013-073-9-005
R5	36 kΩ ±1%, 1/8 W Metal Film	013-053-9-004
R7, 8	3 kΩ ±1%, 1/8 W Metal Film	013-052-9-023
R9	3.6 kΩ ±1%, 1/8 W Metal Film	013-053-9-002
R20	360 kΩ ±1%, 1/8 W Metal Film	013-051-9-002
R21	120 kΩ ±1%, 1/8 W Metal Film	013-053-9-005
R22, 23	30 kΩ ±1%, 1/8 W Metal Film	013-073-9-005
R24	36 kΩ ±1%, 1/8 W Metal Film	013-053-9-004
R25	12 kΩ ±1%, 1/8 W Metal Film	013-053-9-003
R26, 27	3 kΩ ±1%, 1/8 W Metal Film	013-052-9-023
R28	3.6 kΩ ±1%, 1/8 W Metal Film	013-053-9-002

CAPACITORS

C1-4	.01 µF ±20%, 50 V Ceramic Disc	020-296-9-001

DIODES

D1-7, 8*, 9-15, 16*	GMA-01, Silicon Diode	151-111-9-001

SWITCHES

S1*, 2*	Switch Assembly, A SWEEP TIME/DIV, B SWEEP TIME/DIV, and A VARIABLE	083-289-9-001
S1**, 2**	Switch Assembly, A SWEEP TIME/DIV, B SWEEP TIME/DIV, and A VARIABLE	083-286-9-002

* = Used only in Model 1590
** = Used only in Model 1570

SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.
	"A" TRIG SWITCH ASSEMBLY (Model 1590 X77-1110-00) (Model 1570 X77-1110-01)	
	RESISTORS	
	Standard value resistors are not listed. These are readily available from your local parts distributor. See schematic diagram for value. Unless specified otherwise on schematic, such resistors are ±5%, 1/8 W.	
R26, 27	3 kΩ ±1%, 1/8 W Metal Film	013-052-9-023
R32, 33	220 Ω ±1%, 1/8 W Metal Film	013-052-9-020
R34, 35	1.5 kΩ ±1%, 1/8 W Metal Film	013-052-9-022
R36	750 Ω ±1%, 1/8 W Metal Film	013-052-9-017
R37, 38	270 Ω ±1%, 1/8 W Metal Film	013-052-9-021
VR1/S3/S4*	5 kΩ Potentiometer with Push-Pull and Rotary Switch, TRIG LEVEL Control	008-406-9-009
VR1/S4**	5 kΩ Potentiometer with Rotary Switch, TRIG LEVEL Control	008-434-9-006
VR2	10 kΩ Trimpot	008-434-9-007
VR3	100 Ω Trimpot	008-434-9-004
VR4*	1 kΩ Trimpot	008-434-9-015
	CAPACITORS	
C1	.01 µF, 630 V Metal Film	033-023-9-002
C2, 3	68 pF ±5%, 50 V Ceramic Disc	020-215-9-008
C4*, 5*	10 µF ±20%, 25 V Electrolytic	022-225-9-003
C6	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C7	3.3 µF ±20%, 50 V Electrolytic	022-226-9-009
C8	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C9, 10, 13	22 pF ±5%, 50 V Ceramic Disc	020-215-9-002
C14	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C15	1 µF, 35 V Tantalum	033-054-9-001
C16, 17	33 µF ±20%, 16 V Electrolytic	022-226-9-008
C18-22	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C23	1 µF, 35 V Tantalum	033-054-9-001
C24, 25	33 µF ±20%, 16 V Electrolytic	022-226-9-008
C26-28, 30-31	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
TC1	20 pF Trimmer	028-065-9-004
	DIODES AND TRANSISTORS	
D1-5	DS442X, Silicon Switching Diode	151-097-9-001
Q1*	2SJ43(Q) FET	182-064-9-003
Q2*	2SK127(Q) FET	182-064-9-002
Q3, 4	2SC536KNP-F, NPN Silicon Signal Transistor	176-114-9-001
Q5	DN1901, Dual FET	182-070-9-001
Q6, 7	2SC1215-T or -S, NPN Silicon Signal Transistor	176-114-9-003
Q8, 9	2SA1161, PNP Silicon Signal Transistor	177-018-9-003
Q10	2SC2671, NPN Silicon Signal Transistor	176-130-9-001
	INTEGRATED CIRCUITS	
IC1	CA3102E, Linear IC	307-259-9-018

* = Used only in Model 1590
** = Used only in Model 1570

SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.
	MISCELLANEOUS	
L1, 2	22 µH Ferri-Inductor	041-068-9-004
S1*	Lever Switch, SOURCE	080-014-9-001
S1**	Lever Switch, SOURCE	080-004-9-002
S2	Lever Switch, COUPLING	080-003-9-002

* = Used only in Model 1590
** = Used only in Model 1570

SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.
	"B" TRIG SWITCH ASSEMBLY (Model 1590 X77-1120-00) (Model 1570 X77-1120-01)	
	RESISTORS	
	Standard value resistors are not listed. These are readily available from your local parts distributor. See schematic diagram for value. Unless specified otherwise on schematic, such resistors are ±5%, 1/8 W.	
R13, 14	3 kΩ ±1%, 1/8 W Metal Film	013-052-9-023
R19, 20	220 Ω ±1%, 1/8 W Metal Film	013-052-9-020
R21, 22	1.5 kΩ ±1%, 1/8 W Metal Film	013-052-9-022
R23	750 Ω ±1%, 1/8 W Metal Film	013-052-9-017
R24, 25	270 Ω ±1%, 1/8 W Metal Film	013-052-9-021
VR1/S3/S4*	5 kΩ Potentiometer with Rotary and Push-Pull Switch, TRIG LEVEL Control	008-406-9-021
VR1/S3**	5 kΩ Potentiometer with Rotary Switch, TRIG LEVEL Control	008-434-9-008
VR2	10 kΩ Trimpot	008-434-9-007
VR3	100 Ω Trimpot	008-434-9-004
	CAPACITORS	
C1	.01 µF, 630 V Metal Film	033-023-9-002
C2*, 3*	68 pF ±0.5 pF, 50 V Ceramic Disc	020-142-9-006
C4	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C5, 6	22 pF ±5%, 50 V Ceramic Disc	020-215-9-002
C9, 10	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C11	1 µF, 35 V Tantalum	033-054-9-001
C12, 13	33 µF ±20%, 16 V Electrolytic	022-226-9-008
C14-17	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C18	1 µF, 35 V Tantalum	033-054-9-001
C19, 20	33 µF ±20%, 16 V Electrolytic	022-226-9-008
C21-23	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C24*	10 µF ±20%, 16 V Electrolytic	022-226-9-014
TC1	20 pF Trimmer	028-065-9-004
	DIODES AND TRANSISTORS	
D1	WZ-081, 8.1 V Zener Diode	152-054-9-001
Q1	2SC1215-T or -S, NPN Silicon Signal Transistor	176-114-9-003
Q2	DN1901, Dual FET	182-070-9-001
Q3, 4	2SC1215-T or -S, NPN Silicon Signal Transistor	176-114-9-003
Q5, 6	2SA1161, PNP Silicon Signal Transistor	177-048-9-003
Q7	2SC2671, NPN Silicon Signal Transistor	176-114-9-006
	INTEGRATED CIRCUITS	
IC1	CA3102E, Linear IC	307-259-9-018
	MISCELLANEOUS	
L1, 2	22 µH Ferri-Inductor	041-068-9-004
S1	Lever Switch, SOURCE	080-004-9-002
S2*	Lever Switch, COUPLING	080-004-9-002

* = Used only in Model 1590
** = Used only in Model 1570

TRIGGER & SWEEP ASSEMBLY
(Model 1590 X74-1320-00)
(Model 1570 X74-1320-01)

RESISTORS

Standard value resistors are not listed. These are readily available from your local parts distributor. See schematic diagram for value. Unless specified otherwise on schematic, such resistors are ±5%, 1/6 W.

SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.
R43	2.4 kΩ ±1%, 1/8 W Metal Film	013-052-9-029
R44	5.1 kΩ ±1%, 1/8 W Metal Film	013-052-9-003
R49	15 kΩ ±1%, 1/8 W Metal Film	015-144-1-502
R50	12 kΩ ±1%, 1/8 W Metal Film	013-053-9-003
R51	10 kΩ ±1%, 1/8 W Metal Film	015-144-1-002
R52	43 kΩ ±1%, 1/8 W Metal Film	013-073-9-002
R55, 56	3.9 kΩ ±1%, 1/8 W Metal Film	013-052-9-002
R98	510 Ω ±1%, 1/8 W Metal Film	013-073-9-001
R101, 102	4.7 kΩ ±1%, 1/8 W Metal Film	013-052-9-030
R144	5.1 kΩ ±1%, 1/8 W Metal Film	013-052-9-003
R145	7.5 kΩ ±1%, 1/8 W Metal Film	015-144-7-501
R147	2.4 kΩ ±1%, 1/8 W Metal Film	013-052-9-029
R149	15 kΩ ±1%, 1/8 W Metal Film	015-144-1-502
R150	12 kΩ ±1%, 1/8 W Metal Film	013-053-9-003
R151	43 kΩ ±1%, 1/8 W Metal Film	013-073-9-002
R152	10 kΩ ±1%, 1/8 W Metal Film	015-144-1-002
R154, 155	3.9 kΩ ±1%, 1/8 W Metal Film	013-052-9-002
R198	4.7 kΩ ±1%, 1/8 W Metal Film	013-052-9-030
R200	3.3 kΩ ±1%, 1/8 W Metal Film	013-073-9-003
R201	1.2 kΩ ±1%, 1/8 W Metal Film	013-052-9-034
R206	3.3 kΩ ±1%, 1/8 W Metal Film	013-073-9-003
R207	6.2 kΩ ±1%, 1/8 W Metal Film	013-073-9-004
R210, 211	470 Ω ±1%, 1/8 W Metal Film	013-052-9-027
R212, 214	2.2 kΩ ±1%, 1/8 W Metal Film	013-052-9-028
R215, 216	1.6 kΩ ±1%, 1/8 W Metal Film	013-052-9-033
R219, 220	1 kΩ ±1%, 1/8 W Metal Film	013-052-9-043
R221	150 Ω ±1%, 1/8 W Metal Film	013-052-9-031
R222, 223	1 kΩ ±1%, 1/8 W Metal Film	013-052-9-043
R224	4.7 kΩ ±1%, 1/8 W Metal Film	013-052-9-030
R225	2 kΩ ±1%, 1/8 W Metal Film	013-052-9-018
R237	4.7 kΩ ±1%, 1/8 W Metal Film	013-052-9-030
R239	1.2 kΩ ±1%, 1/8 W Metal Film	013-052-9-034
R240	3.3 kΩ ±1%, 1/8 W Metal Film	013-073-9-003
R241	2.2 kΩ ±1%, 1/8 W Metal Film	013-052-9-028
R242, 243	6.8 kΩ ±1%, 1/8 W Metal Film	013-052-9-025
VR1-4	20 kΩ Trimpot	008-446-9-001
VR5	5 kΩ Trimpot	008-434-9-011
VR6	200 Ω Trimpot	008-434-9-001
VR7, 8	1 kΩ Trimpot	008-434-9-012
VR9, 10	5 kΩ Trimpot	008-434-9-011
VR11, 12	2 kΩ Trimpot	008-434-9-011
VR13	100 Ω Trimpot	008-434-9-002

* = Used only in Model 1590
** = Used only in Model 1570

SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.
VR14	200 Ω Trimpot	008-434-9-001
VR15	5 kΩ Trimpot	008-434-9-011
	CAPACITORS	
C2	4700 µF ±20%, 16 V Electrolytic	022-225-9-003
C3	100 pF ±5%, 50 V Ceramic Disc	020-096-9-006
C4	0.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C5	100 pF ±5%, 50 V Ceramic Disc	020-096-9-006
C6, 8	10 µF ±20%, 25 V Electrolytic	022-086-9-005
C9	1 µF ±20%, 50 V Electrolytic	022-226-9-017
C10	22 µF ±20%, 35 V Electrolytic	022-244-9-001
C11	3.3 µF ±20%, 50 V Electrolytic	022-226-9-009
C12	0.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C14	10 µF ±1%, 100 V Polyester	033-065-9-001
C15, 16	0.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C17	0.1 µF ±1%, 100 V Polypropylene	030-062-9-001
C18	0.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C19	0.033 µF ±10%, 50 V Mylar	025-056-9-004
C20	0.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C21	1000 pF ±1%, 100 V Polypropylene	030-062-9-001
C22	0.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C23	330 pF ±5%, 50 V Ceramic Disc	020-158-9-004
C24	47 pF ±5%, 50 V Ceramic Disc	020-103-9-003
C25	68 pF ±5%, 100 V Mica	023-079-9-001
C26	0.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C27	33 pF ±5%, 50 V Ceramic Disc	020-149-9-005
C28	10 µF ±20%, 25 V Electrolytic	022-086-9-005
C29	33 pF ±5%, 50 V Ceramic Disc	020-103-9-002
C33, 34	10 µF ±20%, 25 V Electrolytic	022-086-9-005
C36	3.3 µF ±20%, 50 V Electrolytic	022-226-9-009
C37	10 µF ±1%, 100 V Polyester	033-065-9-001
C38*	10 µF ±20%, 25 V Electrolytic	022-086-9-005
C39	0.1 µF ±1%, 100 V Polypropylene	030-062-9-001
C40*	0.1 µF, 12 V Semiconductor Ceramic	033-018-9-001
C41	1000 pF ±1%, 100 V Polypropylene	030-062-9-001
C42	1000 pF ±10%, 50 V Ceramic Disc	020-249-9-001
C43*	100 pF ±5%, 50 V Ceramic Disc	020-096-9-006
C44	68 pF ±5%, 100 V Mica	023-079-9-001
C46, 47	0.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C48	47 µF ±20%, 16 V Electrolytic	022-226-9-012
C49, 50	0.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C51	330 pF ±5%, 50 V Ceramic Disc	020-158-9-004
C54	1 µF ±20%, 50 V Electrolytic	022-226-9-017
C55-56, 59-63	0.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C64	4700 pF ±10%, 500 V Ceramic Disc	020-302-9-003
C65	0.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C66	4700 pF ±10%, 500 V Ceramic Disc	020-302-9-003
C67-70	0.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C71	4700 pF ±10%, 500 V Ceramic Disc	020-302-9-003
C72-74	0.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001

* = Used only in Model 1590
** = Used only in Model 1570

SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.
C77-89	0.1 µF, 12 V Semiconductor Ceramic	033-018-9-001
C92, 93	100 µF ±20%, 10 V Electrolytic	022-226-9-013
C94	47 µF ±20%, 10 V Electrolytic	022-119-9-004
C95	100 µF ±20%, 10 V Electrolytic	022-226-9-013
C97	220 µF ±20%, 10 V Electrolytic	022-225-9-001
C98	47 µF ±20%, 16 V Electrolytic	022-226-9-012
C99	330 µF ±20%, 25 V Electrolytic	022-244-9-003
C100, 101	47 µF ±20%, 16 V Electrolytic	022-226-9-012
C102, 103	100 µF ±20%, 16 V Electrolytic	022-225-9-002
C104	22 µF ±20%, 25 V Electrolytic	022-119-9-005
C105	33 µF ±20%, 25 V Electrolytic	022-135-9-001
C106	22 µF ±20%, 25 V Electrolytic	022-119-9-005
C107	100 µF ±20%, 25 V Electrolytic	022-226-9-002
C110, 111	10 µF ±20%, 63 V Electrolytic	022-244-9-002
C112	33 µF ±20%, 16 V Electrolytic	022-226-9-008
C113	22 µF ±20%, 25 V Electrolytic	022-119-9-005
C114, 115	33 µF ±20%, 16 V Electrolytic	022-226-9-008
C116	1 µF ±20%, 50 V Electrolytic	022-226-9-017
C118-120*, 121-123, 124*	0.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C127, 128	0.1 µF, 12 V Semiconductor Ceramic	033-018-9-001
C129	33 µF ±20%, 16 V Electrolytic	022-226-9-008
TC1, 2	20 pF Trimmer	028-057-9-001
TC3, 4	6 pF Trimmer	028-065-9-003
	DIODES	
D1	SV03Y, Varistor	153-022-9-001
D2-5	GMA-01, Silicon Diode	151-111-9-001
D6, 7	DS442X, Silicon Switching Diode	151-097-9-001
D8-11	GMA-01, Silicon Diode	151-111-9-001
D12	WZ-150, 15 V Zener Diode	152-070-9-001
D13	DS442X, Silicon Switching Diode	151-097-9-001
D14*	1N60 Germanium Diode	150-001-9-005
D15, 16	GMA-01, Silicon Diode	151-111-9-001
D17	YZ-030, 3.0 V Zener Diode	152-099-9-002
D18	GMA-01, Silicon Diode	151-111-9-001
D19	SV03Y, Varistor	153-022-9-001
D20, 21, 23	GMA-01, Silicon Diode	151-111-9-001
D24, 25	DS442X, Silicon Switching Diode	151-097-9-001
D26, 27	GMA-01, Silicon Diode	151-111-9-001
D28	WZ-150, 15 V Zener Diode	152-070-9-001
D29	DS442X, Silicon Switching Diode	151-097-9-001
D32-36	GMA-01, Silicon Diode	151-111-9-001
D37, 38	WZ-120, 12 V Zener Diode	152-110-9-001
D40-43	GMA-01, Silicon Diode	151-111-9-001
D45	SV06Y, Varistor	153-019-9-001
D46, 48-50	GMA-01, Silicon Diode	151-111-9-001
D51	WZ-100, 10 V Zener Diode	152-050-9-002
D52-58	GMA-01, Silicon Diode	151-111-9-001

* = Used only in Model 1590
** = Used only in Model 1570

SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.
D60-64	GMA-01, Silicon Diode	151-111-9-001
D65	SV06Y, Varistor	153-019-9-001
D66	GMA-01, Silicon Diode	151-111-9-001
	TRANSISTORS	
Q3, 4	2SC536KNP-F, NPN Silicon Signal Transistor	176-114-9-001
Q5	2SA838-C, PNP Silicon Signal Transistor	177-036-9-001
Q6	2SC1215-T or -S, NPN Silicon Signal Transistor	176-114-9-003
Q7	2SC1973-T, NPN Silicon Signal Transistor	176-099-9-002
Q8	2SA838-C, PNP Silicon Signal Transistor	177-036-9-001
Q9	2SD438-F, NPN Silicon Power Transistor	172-058-9-002
Q10-18	2SC536KNP-F, NPN Silicon Signal Transistor	176-114-9-001
Q19	M74F-C, Dual FET	182-071-9-001
Q20	2SC1047-C, NPN Silicon Signal Transistor	176-075-9-001
Q21	M74F-C, Dual FET	182-071-9-001
Q22	2SA838-C, PNP Silicon Signal Transistor	177-036-9-001
Q23	2SC1047-C, NPN Silicon Signal Transistor	176-075-9-001
Q24-26	2SC536KNP-F, NPN Silicon Signal Transistor	176-114-9-001
Q27*, 28*	2SA838-C, PNP Silicon Signal Transistor	177-036-9-001
Q29, 30	2SA838-C, PNP Silicon Signal Transistor	177-036-9-001
Q32	2SC536KNP-F, NPN Silicon Signal Transistor	176-114-9-001
Q33	2SC536KNP-F, NPN Silicon Signal Transistor	176-114-9-001
Q34	2SA838-C, PNP Silicon Signal Transistor	177-036-9-001
Q35	2SC1215-T or -S, NPN Silicon Signal Transistor	176-114-9-003
Q36	2SC1973-T, NPN Silicon Signal Transistor	176-099-9-002
Q37	2SA838-C, PNP Silicon Signal Transistor	177-036-9-001
Q38	2SD438-F, NPN Silicon Power Transistor	172-058-9-002
Q39-41	2SC536KNP-F, NPN Silicon Signal Transistor	176-114-9-001
Q42*	2SC536KNP-F, NPN Silicon Signal Transistor	176-114-9-001
Q43	2SC536KNP-F, NPN Silicon Signal Transistor	176-114-9-001
Q44*	2SC536KNP-F, NPN Silicon Signal Transistor	176-114-9-001
Q45	2SC536KNP-F, NPN Silicon Signal Transistor	176-114-9-001
Q46*	2SC536KNP-F, NPN Silicon Signal Transistor	176-114-9-001
Q47	2SC536KNP-F, NPN Silicon Signal Transistor	176-114-9-001
Q48	M74F-C, Dual FET	182-071-9-001
Q49	2SC1047-C, NPN Silicon Signal Transistor	176-075-9-001
Q50*	2SA838-C, PNP Silicon Signal Transistor	177-036-9-001
Q51	M74F-C, Dual FET	182-071-9-001
Q52*	2SC1047-C, NPN Silicon Signal Transistor	176-075-9-001
Q53, 54	2SC536KNP-F, NPN Silicon Signal Transistor	176-114-9-001
Q55-61	2SC1047-C, NPN Silicon Signal Transistor	176-075-9-001
Q62, 63	2SA838-C, PNP Silicon Signal Transistor	177-036-9-001
Q64-67	2SC1047-C, NPN Silicon Signal Transistor	176-075-9-001
Q68, 69	2SC536KNP-F, NPN Silicon Signal Transistor	176-114-9-001
Q70, 71	2SC1047-C, NPN Silicon Signal Transistor	176-075-9-001
Q72	2SA838-C, PNP Silicon Signal Transistor	177-036-9-001
Q73	2SC1215-T or -S, NPN Silicon Signal Transistor	176-114-9-003
Q74	2SA838-C, PNP Silicon Signal Transistor	177-036-9-001
Q75	2SC1215-T or -S, NPN Silicon Signal Transistor	176-114-9-003
Q76*	2SA838-C, PNP Silicon Signal Transistor	177-036-9-001

* = Used only in Model 1590
** = Used only in Model 1570

SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.
Q77, 78	2SA838-C, PNP Silicon Signal Transistor	177-036-9-001
Q79	2SC536KNP-F, NPN Silicon Signal Transistor	176-114-9-001
Q80	2SA838-C, PNP Silicon Signal Transistor	177-036-9-001
Q81	2SC536KNP-F, NPN Silicon Signal Transistor	176-114-9-001
	INTEGRATED CIRCUITS	
IC1	MC10103L, CMOS IC	307-309-9-003
IC2	MC10131L, CMOS IC	307-309-9-005
IC3	TL082CP, Linear IC	307-259-9-019
IC4	MC10103L, CMOS IC	307-309-9-003
IC5	MC10131L, CMOS IC	307-309-9-005
IC6	TL082CP, Linear IC	307-259-9-019
IC7	MC10104L, CMOS IC	307-309-9-004
IC8	MC10103L, CMOS IC	307-309-9-003
IC9*, 10, 11	MC10104L, CMOS IC	307-309-9-004
IC12	MC10102L, CMOS IC	307-301-9-001
IC13	MC10131L, CMOS IC	307-309-9-005
IC14	SN7405N, Digital IC	307-309-9-006
IC15	MC10104L, CMOS IC	307-309-9-004
IC16	MC78L15CP, 15 Volt Regulator	307-309-9-002
	MISCELLANEOUS	
L1, 2	10 μH Ferri-Inductor	041-133-9-006

* = Used only in Model 1590
** = Used only in Model 1570

SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.

HORIZONTAL MODE CONTROL ASSEMBLY
(Model 1590 X77-1130-00)
(Model 1570 X77-1130-01)

RESISTORS

Standard value resistors are not listed. These are readily available from your local parts distributor. See schematic diagram for value. Unless specified otherwise on schematic, such resistors are ±5%, 1/8 W.

R70	360 Ω ±1%, 1/8 W Metal Film	013-052-9-011
R71	30 Ω ±1%, 1/8 W Metal Film	013-052-9-009
R76	100 kΩ ±1%, 1/8 W Metal Film	013-052-9-015
R77	91 kΩ ±1%, 1/8 W Metal Film	013-052-9-014
R80*	900 kΩ ±1%, 1/4 W Metal Film	013-034-9-044
R81*	111 kΩ ±1%, 1/2 W Metal Film	013-034-9-036
R83	1 MΩ ±1%, 1/2 W Metal Film	013-008-9-023
R86, 87	2.7 kΩ ±1%, 1/8 W Metal Film	013-052-9-013
R91, 92	820 Ω ±1%, 1/8 W Metal Film	013-052-9-012
R94, 95	39 Ω ±1%, 1/8 W Metal Film	013-052-9-010
R98*	900 kΩ ±1%, 1/4 W Metal Film	013-034-9-044
R99*	111 kΩ ±1%, 1/2 W Metal Film	013-034-9-036
R101	1 MΩ ±1%, 1/2 W Metal Film	013-008-9-023
R104, 105	2.7 kΩ ±1%, 1/8 W Metal Film	013-052-9-013
R109, 110	820 Ω ±1%, 1/8 W Metal Film	013-052-9-012
R112, 113	39 Ω ±1%, 1/8 W Metal Film	013-052-9-010
VR1	200 Ω Trimpot	008-434-9-009
VR2	100 kΩ Trimpot	008-434-9-010
VR3, 4	200 Ω Trimpot	008-434-9-009
VR5*	100 Ω Trimpot	008-434-9-004

CAPACITORS

C1-4, 5*, 6	100 pF ±5%, 50 V Ceramic Disc	020-096-9-006
C7	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C8-11	100 pF ±5%, 50 V Ceramic Disc	020-096-9-006
C12-14	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C15	470 µF ±20%, 16 V Electrolytic	022-226-9-006
C22	470 pF ±5%, 50 V Ceramic Disc	020-233-9-003
C23**	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C26	470 µF ±20%, 16 V Electrolytic	022-226-9-006
C27, 28	4700 pF ±1%, 100 V Polypropylene	025-179-9-001
C29*	39 pF ±5%, 50 V Ceramic Disc	020-171-9-006
C30	0.047 µF, 630 V Metal Film	033-023-9-001
C31, 32, 33*, 34	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C35*	39 pF ±5%, 50 V Ceramic Disc	020-171-9-006
C36	0.047 µF, 630 V Metal Film	033-023-9-001
C37*	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C38*	470 µF ±20%, 16 V Electrolytic	022-226-9-006
C39*, 40	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C41	470 µF ±20%, 16 V Electrolytic	022-226-9-006
C42	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001

* = Used only in Model 1590
** = Used only in Model 1570

SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.
C43	470 µF ±20%, 16 V Electrolytic	022-226-9-006
C44	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C45	470 µF ±20%, 16 V Electrolytic	022-226-9-006
C47, 48	10 pF ±0.5 pF, 50 V Ceramic Disc	020-215-9-001
C100**	1000 µF, 10 V Electrolytic	033-060-9-001
TC1, 2*	10 pF Trimmer	028-065-9-002
TC3*	6 pF Trimmer	028-065-9-001
TC4, 5*	10 pF Trimmer	028-065-9-002
TC6*	6 pF Trimmer	028-065-9-001
TC7*	20 pF Trimmer	028-057-9-001
	DIODES	
D1-24, 31	DS442X, Silicon Switching Diode	151-097-9-001
D38*	1N60, Germanium Diode	150-001-9-005
D39, 40	DS442X, Silicon Switching Diode	151-097-9-001
D41	1S1544A, Silicon Diode	151-096-9-001
D42-45	DS442X, Silicon Switching Diode	151-097-9-001
D47	1S1544A, Silicon Diode	151-096-9-001
D48-51, 53-54, 100**	DS442X, Silicon Switching Diode	151-097-9-001
	TRANSISTORS	
Q1-4	2SC536KNP-F, NPN Silicon Signal Transistor	176-114-9-001
Q5, 6	2SA608KNP-F, PNP Silicon Signal Transistor	177-048-9-001
Q7	2SC536KNP-F, NPN Silicon Signal Transistor	176-114-9-001
Q10-12	2SA608KNP-F, PNP Silicon Signal Transistor	177-048-9-001
Q13	DN1901, Dual FET	182-070-9-001
Q14, 15	2SC1215-T or -S, NPN Silicon Signal Transistor	176-114-9-003
Q16*	2SD438-F, NPN Power Transistor	172-058-9-002
Q17	DN1901, Dual FET	182-070-9-001
Q18, 19	2SC1215-T or -S, NPN Silicon Signal Transistor	176-114-9-003
Q20*	2SD438-F, NPN Power Transistor	172-058-9-002
	INTEGRATED CIRCUITS	
IC1	MC14584BCP, CMOS IC	307-259-9-007
IC2	MC14069UBCP, CMOS IC	307-259-9-004
IC3	MC14001BCP, CMOS IC	307-259-9-001
IC4	MC14174BCP, CMOS IC	307-259-9-005
IC5	MC14503BCP, CMOS IC	307-259-9-006
IC6	SN7442AN, Digital IC	307-259-9-008
IC7	MC14013BCP, CMOS IC	307-259-9-003
IC8	MC14011BCP, CMOS IC	307-259-9-002
IC9	SN74LS04N, Digital IC	307-259-9-009
IC17	MC78L05CP, Regulator IC	307-305-9-001
	MISCELLANEOUS	
L1	47 µH Ferri-Inductor	041-068-9-002
L2*	100 µH Ferri-Inductor	041-124-9-001
L3	47 µH Ferri-Inductor	041-068-9-002
L4, 5	100 µH Ferri-Inductor	041-124-9-001

* = Used only in Model 1590
** = Used only in Model 1570

SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.
RL1*, 2*	Relay	441-030-9-001
	Lithium Battery*	213-005-9-001

HORIZONTAL OUTPUT AMP ASSEMBLY
(Model 1590 X74-1230-00)
(Model 1570 X74-1230-01)

RESISTORS

Standard value resistors are not listed. These are readily available from your local parts distributor. See schematic diagram for value. Unless specified otherwise on schematic, such resistors are ±5%, 1/8 W.

R14, 15	22 kΩ ±5%, 1 W Carbon	001-001-5-223
VR1*	100 Ω Trimpot	008-434-9-004

CAPACITORS

C1	4700 pF ±10%, 500 V Ceramic Disc	020-302-9-003
C2, 5, 6, 9	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C10-13	1 pF ±0.25 pF, 500 V Ceramic Disc	020-142-9-008
C14	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C15-17	4700 pF ±10%, 500 V Ceramic Disc	020-302-9-003
C18	1 µF, 35 V Tantalum	033-054-9-001
C19	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C20	1 µF, 35 V Tantalum	033-054-9-001
C21	4700 pF ±10%, 500 V Ceramic Disc	020-302-9-003
C22	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C23, 24	100 µF ±20%, 16 V Electrolytic	022-225-9-002
C26	10 µF ±20%, 100 V Electrolytic	021-069-9-002
C27	2.2 µF ±20%, 160 V Electrolytic	021-069-9-003
C28	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C29*	7 pF ±0.5 pF, 50 V Ceramic Disc	020-149-9-001

DIODES

D9, 10, 11	DS442X, Silicon Switching Diode	151-097-9-001
D13	WZ-050, 5 V Zener Diode	152-069-9-001

TRANSISTORS

Q1, 2, 5, 6	2SA838-C, PNP Silicon Signal Transistor	177-036-9-001
Q7, 8	2SC805A-2-2 or -3, NPN Silicon Signal Transistor	176-114-9-002
Q9, 10	2SA923-2-2 or -3, PNP Silicon Signal Transistor	177-041-9-001
Q11, 12, 13*	2SC536KNP-F, NPN Silicon Signal Transistor	176-114-9-001

INDUCTORS

L1, 2, 4, 5	100 µH Ferri Inductor	041-133-9-004

* = Used only in Model 1590
** = Used only in Model 1570

SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.

POWER SUPPLY & BLANKING ASSEMBLY
(Model 1590 X68-1310-00)
(Model 1570 X68-1310-01)

RESISTORS

Standard value resistors are not listed. These are readily available from your local parts distributor. See schematic diagram for value. Unless specified otherwise on schematic, such resistors are ±5%, 1/8 W.

R1	51 kΩ ±1%, 1/8 W Metal Film	013-052-9-007
R2	5.1 kΩ ±1%, 1/8 W Metal Film	013-052-9-003
R7	130 kΩ ±1%, 1/8 W Metal Film	013-052-9-008
R8	5.6 kΩ ±1%, 1/8 W Metal Film	013-052-9-004
R11, 12	5.1 kΩ ±1%, 1/8 W Metal Film	013-052-9-003
R15	1.3 kΩ ±1%, 1/8 W Metal Film	013-052-9-001
R16	3.9 kΩ ±1%, 1/8 W Metal Film	013-052-9-002
R20	13 kΩ ±1%, 1/8 W Metal Film	013-052-9-006
R21	8.2 kΩ ±1%, 1/8 W Metal Film	013-052-9-005
R64	68 kΩ 1%, 1/8 W Metal Film	013-065-9-002
R70	15 MΩ, Metal Glaze Film	004-193-9-002
R71*	3.3 MΩ, 1/2 W Solid Resistor	001-102-5-335
R71**	8.2 MΩ, 1/2 W Solid Resistor	001-102-5-825
R72	15 MΩ, 1/2 W Solid Resistor	001-102-5-156
R73	3 MΩ, Metal Glaze Film	004-193-9-001
R74	47 MΩ, Metal Glaze Film	004-181-9-002
R83	220 Ω ±1%, 1/8 W Metal film	013-052-9-020
R84	5.1 kΩ ±1%, 1/8 W Metal Film	013-052-9-003
VR1	10 kΩ Potentiometer with Switch, SCALE ILLUM/POWER Control	008-406-9-006
VR2, 3*	10 kΩ Trimpot,	008-298-9-010
VR4	Dual 1 kΩ Potentiometer, A INTENSITY, B INTENSITY Control	008-406-9-005
VR5	4.7 kΩ Trimpot	008-298-9-009
VR6	10 kΩ Trimpot,	008-298-9-010
VR7	47 kΩ Trimpot	008-298-9-012
VR8	3 MΩ Potentiometer, FOCUS Control	008-390-9-001
VR9, 10*	150 kΩ Trimpot, ASTIG Control	008-406-9-007

CAPACITORS

C1	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C2	10 µF ±20%, 35 V Electrolytic	022-226-9-003
C3	33 µF ±20%, 63 V Electrolytic	022-226-9-005
C4, 5	3.3 µF ±20%, 160 V Electrolytic	021-069-9-001
C6	33 µF ±20%, 16 V Electrolytic	022-226-9-008
C7	1 µF, 35 V Tantalum	033-054-9-001
C8, 9	100 µF ±20%, 25 V Electrolytic	022-226-9-002
C10	220 µF ±20%, 10 V Electrolytic	022-225-9-001
C11	10 µF ±20%, 35 V Electrolytic	022-226-9-003
C12	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C13	47 µF ±20%, 35 V Electrolytic	022-226-9-004
C14, 15, 16*	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001

* = Used only in Model 1590
** = Used only in Model 1570

SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.
C17, 18	68 pF ±5%, 50 V Ceramic Disc	020-142-9-006
C19, 20	4700 pF ±10%, 50 V Ceramic Disc	020-302-9-001
C21, 22	1 µF, 35 V Tantalum	033-054-9-001
C23	22 pF ±5%, 50 V Ceramic Disc	020-215-9-002
C24	1 pF ±0.25 pF, 500 V Ceramic Disc	020-142-9-008
C25	4700 pF ±10%, 500 V Ceramic Disc	020-302-9-003
C26	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C27	1 pF ±0.25 pF, 500 V Ceramic Disc	020-142-9-008
C28	4700 pF ±10%, 500 V Ceramic Disc	020-302-9-003
C29	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C30	3.3 µF ±20%, 160 V Electrolytic	021-069-9-001
C31	4700 pF ±10%, 500 V Ceramic Disc	020-302-9-003
C32	220 µF ±20%, 10 V Electrolytic	022-225-9-001
C33	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C34	100 µF ±20%, 25 V Electrolytic	022-226-9-002
C35	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C36-39	.01 µF ±100/-0%, 2 kV Ceramic Disc	020-124-9-011
C40	1000 pF ±100/-0%, 2 kV Ceramic Disc	020-226-9-002
C41	0.15 µF ±10%, 50 V Mylar	025-192-9-001
C42	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C43	4700 pF ±10%, 50 V Ceramic Disc	020-302-9-001
C44	47 µF ±20%, 25 V Electrolytic	022-226-9-001
C45	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C46	47 µF ±20%, 25 V Electrolytic	022-226-9-001
C47	.01 µF ±10%, 50 V Ceramic Disc	020-296-9-001
C48	47 µF ±20%, 25 V Electrolytic	022-226-9-001
C49	4700 pF ±5%, 50 V Mylar	025-107-9-007
C50	47 µF ±20%, 25 V Electrolytic	022-226-9-001
C51	4700 pF ±10%, 50 V Ceramic Disc	020-302-9-001
C52, 53	.01 µF ±100/-0%, 2 kV Ceramic Disc	020-124-9-011
C54	1000 pF ±100/-0%, 2 kV Ceramic Disc	020-226-9-002
C55, 56*	2200 pF ±10%, 500 V Ceramic Disc	020-302-9-004
C57, 58	100 pF ±5%, 50 V Ceramic Disc	020-096-9-006
C59*	2200 pF ±10%, 500 V Ceramic Disc	020-302-9-004
TC1, 2	20 pF Trimmer	028-050-9-002
TC3	6 pF Trimmer	028-050-9-001
	DIODES	
D1	DS442X, Silicon Switching Diode	151-097-9-001
D2, 3	WZ-120, 12 V Zener Diode	152-110-9-001
D4	WZ-032, 3.2 V Zener Diode	152-119-9-001
D5, 6*	DS442X, Silicon Switching Diode	151-097-9-001
D7	WZ-090, 9 V Zener Diode	152-069-9-002
D8, 9	1SS83, Silicon HV Switching Diode	151-084-9-001
D10-13	W06C, Silicon HV Rectifier Diode	151-052-9-002
D14, 15	DS442X, Silicon Switching Diode	151-097-9-001
D16	WZ-032, 3.2 V Zener Diode	152-119-9-001
D17	DS442X, Silicon Switching Diode	151-097-9-001
D18	WZ-061, 6.1 V Zener Diode	152-052-9-002

* = Used only in Model 1590
** = Used only in Model 1570

SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NO.
	TRANSISTORS	
Q1	2SC1913-Q or -R, NPN Silicon Power Transistor	172-054-9-001
Q2	2SC1505-L, NPN Silicon Power Transistor	172-058-9-001
Q3	2SB633-E, PNP Silicon Power Transistor	173-010-9-001
Q4	2SD613-E, NPN Silicon Transistor	176-104-9-002
Q5	2SB633-E, PNP Silicon Power Transistor	173-010-9-001
Q6	2SC1505-L, NPN Silicon Power Transistor	172-058-9-001
Q7	2SC536KNP-F, NPN Silicon Signal Transistor	176-114-9-001
Q8	2SC1505-L, NPN Silicon Power Transistor	172-058-9-001
Q9	2SC536KNP-F, NPN Silicon Signal Transistor	176-114-9-001
Q10	2SA608KNP-F, PNP Silicon Signal Transistor	177-048-9-001
Q11*	2SC536KNP-F, NPN Silicon Signal Transistor	176-114-9-001
Q12*	2SA608KNP-F, PNP Silicon Signal Transistor	177-048-9-001
Q13, 14, 15	2SC1215-T or -S, NPN Silicon Signal Transistor	176-114-9-003
Q16*	2SC536KNP-F, NPN Silicon Signal Transistor	176-114-9-001
Q17	2SC1047-C, NPN Silicon Signal Transistor	176-075-9-001
Q18	2SA838-C, PNP Silicon Signal Transistor	177-036-9-001
Q19	2SC805A-2, NPN Silicon Signal Transistor	176-114-9-002
Q20	2SA923-2-2 or -3, PNP Silicon Signal Transistor	177-041-9-001
Q21	2SC2910-T, NPN Silicon Signal Transistor	176-126-9-001
Q22	2SA1208-T, PNP Silicon Signal Transistor	177-053-9-001
Q23, 24	2SC2910-T, NPN Silicon Signal Transistor	176-126-9-001
Q25, 26	2SC536KNP-F, NPN Silicon Signal Transistor	176-114-9-001
Q27	2SA608KNP-F, PNP Silicon Signal Transistor	177-048-9-001
Q28	2SK19-BL, FET	182-056-9-001
Q29	2SD613-E, NPN Silicon Transistor	176-104-9-002
	INTEGRATED CIRCUITS	
IC1, 2	NJM4558D, Linear IC	307-139-9-004
	MISCELLANEOUS	
L1	100 µH Ferri-Inductor	041-133-9-004
L2	10 µH Ferri-Inductor	041-133-9-003
L3-6	100 µH Ferri-Inductor	041-133-9-004
L7	100 µH Ferri-Inductor	041-124-9-001
L8, 9	100 µH Ferri-Inductor	041-133-9-004
NL1-4	Neon Lamp, NE-2B	401-024-9-001
PL1-4	Lamp, Scale Illumination	400-082-9-001

* = Used only in Model 1590
** = Used only in Model 1570

CALIBRATION

Unless otherwise stated, all information in this section applies equally to Model 1570 and 1590. Shaded areas highlight differences between models.

GENERAL

This oscilloscope was calibrated at the factory before shipment. Readjustment is recommended only if repairs have been made in a circuit affecting calibration, or if you have reason to believe the unit may be out of calibration. Complete calibration procedures are given in this manual. However, calibration adjustments should be attempted only if the proper test equipment is available, and you are experienced and qualified in its use. If the accuracy of the test equipment used for calibration is less than specified, the accuracy of the oscilloscope will be proportionately degraded. Perform related adjustments only in the specified sequence to prevent undesirable interaction of adjustments.

TEST EQUIPMENT REQUIRED

DC Voltmeter, 1% or better accuracy at 100 mV to 200 V (**B & K-Precision** Model 2815 or 2831 or equivalent).

High Voltage Multiplier Probe, 3% or better accuracy at 1.5 kV, input impedance 100 MΩ or greater (**B & K-Precision** Model PR-28 or equivalent).

Sine Wave Generator, 1% or less distortion at 100 kHz to 500 kHz, 10 mV to 10 V p-p (**B & K-Precision** Model 3010 or 3020 or equivalent).

Oscilloscope, 5 mV per division sensitivity or greater, bandwidth 100 MHz or greater (**B & K-Precision** Model 1590 or equivalent).

2:1 Divider Network, build per Fig. 44.

Frequency Counter, 0.5% or better accuracy, 10 Hz to 10MHz (any **B & K-Precision** Frequency Counter).

Oscilloscope Calibrator, amplitude accuracy of 0.5% or better at 1 kHz at p-p amplitudes of 50 mV, 0.5 V, 5 V, and 10V, time marker accuracy of 0.5% or better at periods of 1 ms, 20 µs, 0.5 µs, 0.2 µs, and 0.1 µs (Zi-Tech 303, Balantine Model 6125, or Tektronix Model PG-506 Calibration Generator, PG-501 Time Mark Generator, and TM-500 Series Mainframe, or equivalent).

Sweep Generator. Sweeps from 1 kHz to at least 120 MHz with amplitude flatness within ±3%. Frequency markers every 20 MHz; every 10 MHz preferred. Wavetek 400 MHz Sweep Generator or equivalent.

PRELIMINARY PROCEDURE

Make surethat line voltage is within 90-132 VAC limits (180-264 VAC for 240 VAC operation). Calibration should be performed only at ambient room temperature of 10° to 35° C and at relative humidity of less than 85%. Warm up the oscilloscope and calibrating instruments thoroughly (30 minutes) before starting. Perform adjustments in the specified sequence.

The locations of all calibration adjustments are shown in Fig. 37. The function of each adjustment is summarized in Table 2, which identifies the assembly on which the adjustment is located, the reference designation, and the function. This table lists the adjustments in reference designation sequence by assembly and is not the sequence of adjustments.

Before starting adjustments, set operating controls as specified in Table 3. Each procedure assumes the operating controls to be in this initial condition and instructions are provided for any changes required.

ADJ	FUNCTION
VERTICAL ATTENUATOR (X75-1120-00 Model 1590) (X75-1120-01 Model 1570)	
TC1	CH 1 10mV input capacitance
TC2	CH 1 20mV input capacitance
TC3	CH 1 50mV input capacitance
TC4	CH 1 10mV waveshape
TC5	CH 1 20mV waveshape
TC6	CH 1 50mV waveshape
TC7	CH 1 0.5V bandwidth
TC8	CH 1 0.5V input capacitance
TC10	CH 1 0.5V waveshape
TC11	CH 1 5mV waveshape
TC12	CH 2 10mV input capacitance
TC13	CH 2 20mV input capacitance
TC14	CH 2 50mV input capacitance
TC15	CH 2 10mV waveshape
TC16	CH 2 20mV waveshape
TC17	CH 2 50mV waveshape
TC18	CH 2 0.5V bandwidth
TC19	CH 2 0.5V input capacitance
TC21	CH 2 0.5V waveshape
TC22	CH 2 5mV waveshape
TC23	CH 1 0.5V waveshape
TC24	CH 2 0.5V waveshape
VR1	CH 1 dc balance
VR2	CH 2 dc balance
VERTICAL PREAMPLIFIER (X73-1320-00 Model 1590) (X73-1320-01 Model 1570)	
TC1	CH 1 sq wave compensation
TC2	CH 1 X5 GAIN sq wave compensation
TC3	CH 3 high freq waveshape
TC4	CH 3 medium freq waveshape
TC5	CH 2 sq wave compensation
TC6	CH 2 X5 GAIN sq wave compensation
TC7	CH 4 high freq waveshape
TC8	CH 4 medium freq waveshape
TC9	CH 1 OUT sq wave compensation
TC10	CH 1 sq wave compensation
TC11	CH 2 sq wave compensation
VR3	CH 1 gain
VR4	CH 1 position
VR5	CH 1 X5 position
VR6	CH 1 X5 gain
VR7	CH 1 dc trigger level
VR8	CH 1 OUT gain
VR9	CH 1 OUT dc trigger level

ADJ	FUNCTION
VR10	CH 3 dc trigger level
VR11	CH 3 gain
VR13	CH 2 gain
VR14	CH 2 position
VR15	CH 2 INV position
VR16	CH 2 X5 position
VR17	CH 2 X5 gain
VR18	X gain adjustment
VR19	CH 2 dc trigger level
VR20	CH 4 dc trigger level
VR21	CH 4 gain
VR22	V MODE dc trigger level
VERTICAL OUTPUT AMPLIFIER (X73-1330-00 Model 1590) (X73-1330-01 Model 1570)	
TC1	CH 1 sq wave compensation
TC3	CH 1 sq wave compensation
VR1	CRT centering
A TRIGGER SWITCH (X77-1110-00 Model 1590) (X77-1110-01 Model 1570)	
TC1	A trigger high freq level
VR2	A trigger fine adjust
VR3	A trigger coarse adjust
*VR4	FIX trigger adjust
B TRIGGER SWITCH (X77-1120-00 Model 1590) (X77-1120-01 Model 1570)	
TC1	B trigger high freq level
VR2	B trigger fine adjust
VR3	B trigger coarse adjust
TRIGGER & SWEEP (X74-1320-00 Model 1590) (X74-1320-01 Model 1570)	
TC1	0.1 µs A sweep time
TC2	0.1 µs B sweep time
TC3	A sweep linearity
TC4	B sweep linearity
VR1	5 µs A sweep time
VR2	50 ms A sweep time
VR3	5 µs B sweep time
VR4	50 ms B sweep time
VR5	long delay cal

ADJ	FUNCTION
VR6	short delay cal
VR7	A sweep length
VR8	B sweep length
VR9	A sweep time
VR10	B sweep time
VR11	B sweep position
VR12	A sweep position
VR13	X10 MAG gain
VR14	X10 MAG centering
VR15	X axis centering
HOR OUTPUT AMPLIFIER (X74-1230-00 Model 1590)	
*VR1	beam finder sweep length
HORIZONTAL MODE CONTROL (X77-1130-00 Model 1590) (X77-1130-01 Model 1570)	
TC1	CH 3 input capacitance
*TC2	CH 3 input capacitance 1/10
*TC3	CH 3 waveshape 1/10
TC4	CH 4 input capacitance
*TC5	CH 4 input capacitance 1/10
*TC6	CH 4 waveshape 1/10
*TC7	CH 3 bandwidth 1/10
VR1	CAL 1 kHz sq wave level
VR2	CAL 1 kHz sq wave freq
*VR5	CH 4 bandwidth 1/10
POWER SUPPLY & BLANKING (X68-1310-00 Model 1590) (X68-1310-01 Model 1570)	
TC1	Z axis blanking
TC2	blanking
TC3	auto-focus waveshape
VR2	trace rotation
*VR3	perpendicularity
VR5	intensity threshold
VR6	auto-focus level
VR7	-1.7 kV
VR9	astigmatism
*VR10	pattern distortion
* = Model 1590 only	

Table 2. Functions of Calibration Adjustments.

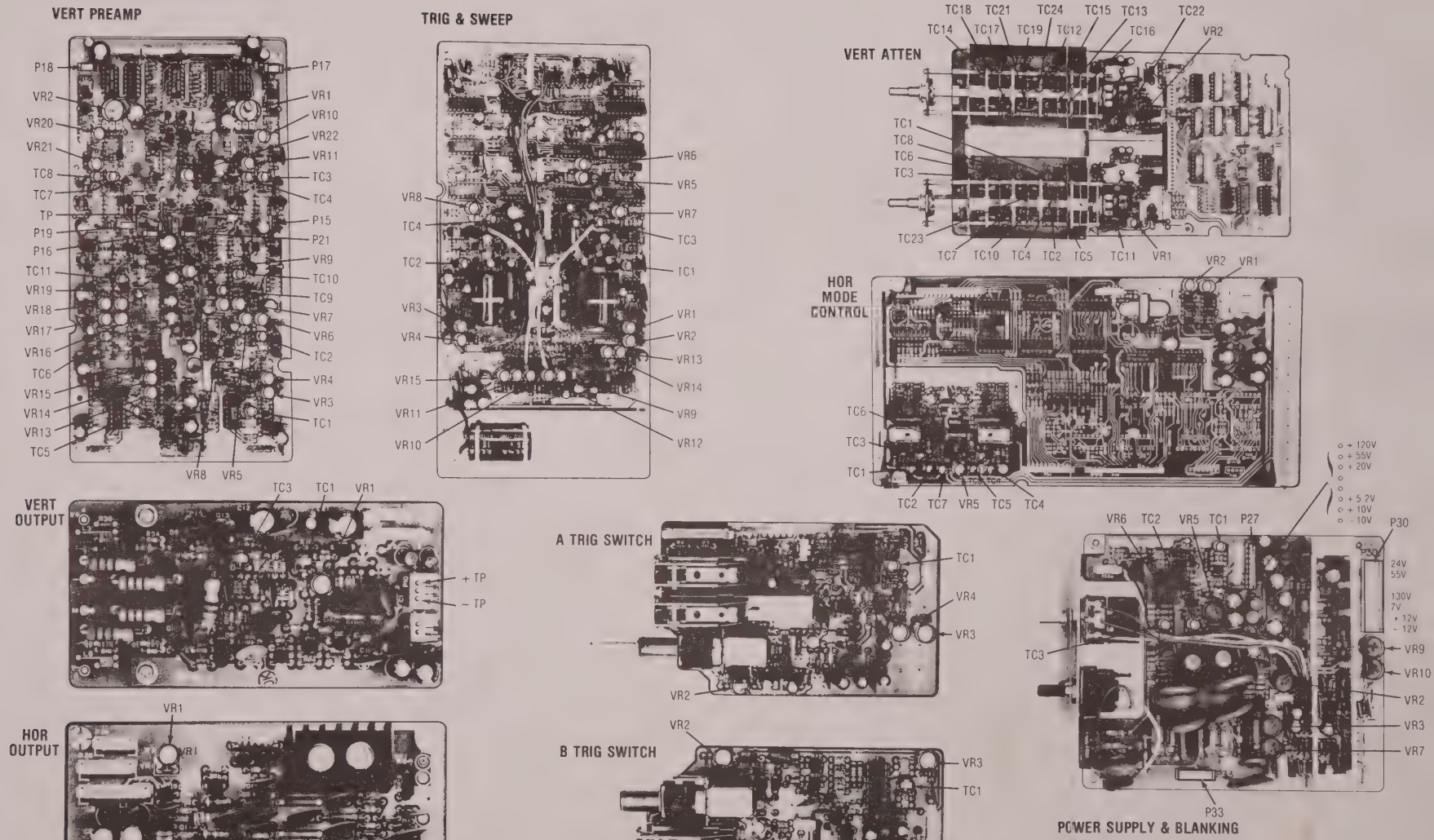


Fig. 37. Locations of Calibration Adjustments

SWITCH OR CONTROL	POSITION
Power Section	
POWER	ON
CRT Control Section	
A INTEN	Between 12 and 3 o'clock position
B INTEN	Between 12 and 3 o'clock position
FOCUS	Optimum focus
SCALE ILLUM	Arbitrary position
BEAM FINDER *	Off
Mode Selection	
Vertical MODE	CH 1
20 MHz BW	Off
CH 2 INV	Off
HORIZONTAL DISPLAY	A
TRIG MODE	AUTO
Vertical Section (CH 1 & 2)	
VARIABLE	CAL
V. POSITION	12 o'clock position
AC-GND-DC	AC
PUSH 50Ω *	Off (out)
VOLTS/DIV	5 V/div
X5 GAIN	Off
* = Model 1590 only.	

SWITCH OR CONTROL	POSITION
Sweep Section	
A SWEEP TIME	0.1 ms/div
B SWEEP TIME	0.1 ms/div
A VAR	CAL
DELAY TIME MULTIPLIER	Arbitrary position
TRACE SEP	Fully counterclockwise
HOLDOFF	NORM
B ENDS A	OFF
H. POSITION	12 o'clock position (coarse and fine)
PULL X10 MAG	Off (in)
PULL CHOP F. SELECT *	Off (in)
Trigger Section	
A TRIG SOURCE	V. MODE
A COUPLING	AC
A TRIG LEVEL	12 o'clock position
A SLOPE	+
PULL FIX *	Off (in)
B TRIG SOURCE	CH 1
B COUPLING *	AC
B TRIG LEVEL	12 o'clock position
B SLOPE	+
PULL STARTS AFTER DELAY *	Off (in)
* = Model 1590 only.	

Table 3. Initial Control Settings for Calibration Adjustments.

POWER SUPPLY AND CRT CHECKS AND ADJUSTMENTS

Before starting adjustments, a check of power supply voltages should be performed to insure proper supply voltages to the various assemblies.

1. Set all controls as indicated in Table 3.
2. Using a digital voltmeter, check the dc voltages at all points listed in Table 4.

The following adjustments are located on the power supply & blanking assembly (X68-1310).

-1.7 kV Adjust

1. Measure CRT cathode voltage at P33, pin 2 with high-impedance, high-voltage dc voltmeter (100 MΩ impedance minimum).
2. Adjust VR7 for -1.750 to -1.755 kV.

Astigmatism

1. Ground channel 1 and 2 inputs (AC-GND-DC switches to GND).

PIN NO.	CONNECTOR P27	CONNECTOR P30
1	+120 V	+24 ±2 V
2	+55 ±1 V	+55 V
3	+20 V	GND
4	- - -	+130 ±3 V
5	-9.8 V *	+7 ±0.5 V
6	+5.2 V	+12 +1.5/-0.5 V
7	+10 V	-12 +0.5/-1.5 V
8	-10 V	- - -
All measurements with respect to chassis.		
* = Model 1590 only		

Table 4. Power Supply Voltage Checks.

2. Turn on the 20 MHz BW switch and set the A INTENSITY control to the 9 o'clock position.
3. Select X-Y mode and position dot in center of screen.
4. Adjust both front panel FOCUS control and VR9 (astigmatism) for roundest spot.

Intensity Threshold

1. Turn off the 20 MHz BW switch.
2. Ground channel 1 and 2 inputs (AC-GND-DC switches to GND).
3. Select X-Y horizontal mode.
4. Rotate A INTENSITY control back and forth. Adjust VR5 so spot just disappears at 9 o'clock position of A INTENSITY control.
5. Check B INTENSITY as follows:
   a. Select AC coupling of channel 1 input (AC-GND-DC to AC) and set B SWEEP TIME to 0.1 ms/div.
   b. Select CH 1 vertical mode, ALT horizontal mode, and AUTO trigger mode.
   c. Select the "Starts After Delay" mode; for Model 1590 pull out the PULL - STARTS AFTER DELAY knob, for Model 1570 set B SOURCE switch to STARTS AFTER DELAY position.
   d. Position TRACE SEP control so that both the A sweep and B sweep are visible, but B sweep remains near vertical center of CRT screen.
   e. Rotate the B INTENSITY control fully counterclockwise and check that the B sweep trace becomes extinguished. If trace is not extinguished, readjust VR5.

Blanking

1. Select CH 1 vertical mode, A horizontal mode, and AUTO trigger mode.
2. Select V. MODE trigger source and AC trigger coupling.
3. Select fastest sweep rate; .02 µs/div for Model 1590 and .05 µs/div for Model 1570.
4. Apply sufficient 100 MHz sine wave input to channel 1 for five divisions vertical deflection (if unable to display 100 MHz signal, use highest frequency that gives synchronized display. Signal should be at least 10 MHz).
5. Set A INTENSITY control so trace is barely visible and set ◄ ► POSITION control so beginning of trace is visible. The beginning of the trace will have less brightness, or will not be visible. Adjust TC2 so that brightness begins as near the start of the trace as possible (Fig. 38).

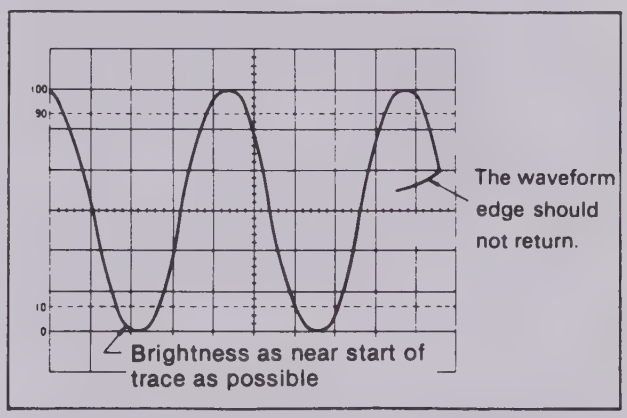


Fig. 38. Blanking Adjustment.

Z Axis Blanking

1. Perform "Blanking" adjustments.
2. Set channel 1 sensitivity to 1 V/div, AC-GND-DC switch to DC, and A SWEEP TIME to 1 µs/div.
3. Apply identical 500 kHz sine wave (approximately 5 volts peak-to-peak) to CH 1 and Z AXIS inputs. A waveform of about 5 divisions amplitude should be displayed.
4. Set A INTENSITY control to minimum and adjust amplitude of input waveform so just the positive tips (approx. 1 to 1-1/2 division) of the waveform are visible.
5. Adjust TC1 for unblanking symmetry; that is, so the beginning and ending of the visible portion occur at equal vertical points. If symmetry cannot be achieved, adjust for maximum length of brightness on waveform's falling edge (Fig. 39).

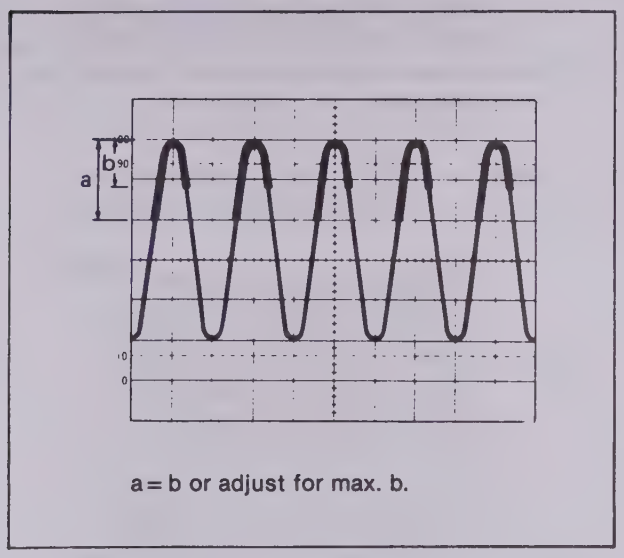


Fig. 39. Z Axis Blanking Adjustment.

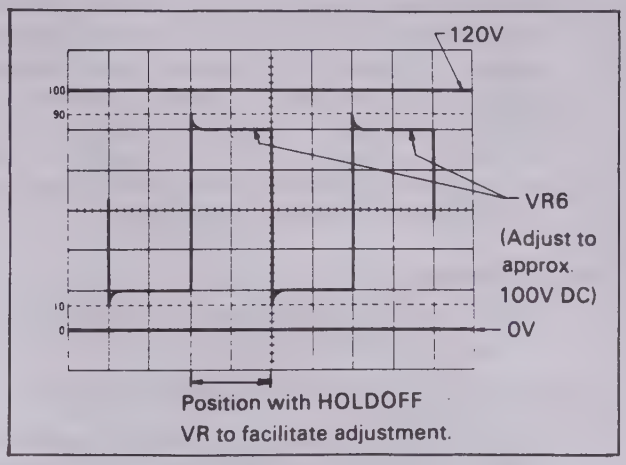


Fig. 40. Auto Focus Amplitude Adjustment.

Auto-Focus

1. Select CH 1 vertical mode, A horizontal mode, and AUTO trigger mode.
2. Select V. MODE trigger source and AC trigger coupling.
3. Set HOLDOFF control to NORM and A SWEEP TIME to 20 µs/div.
4. Turn A INTENSITY control to maximum (fully clockwise).
5. Set up a second Model 1590 or 1570 Oscilloscope (or equivalent accurately calibrated scope) to measure a 0 to +100 volt square wave via a 10:1 probe; DC coupling must be used.
6. Measure the waveform at the Auto-Focus test point (Q22 collector on X68-1310 board) with the second oscilloscope.
   a. Adjust VR6 so the top of the square wave (not including any overshoot peaks) is +100 volts dc. Be sure to reference measurement to 0 volts dc, not necessarily the bottom of the pulse waveform (Fig. 40).
   b. Adjust TC3 for best square wave wave-shape (Fig. 41).

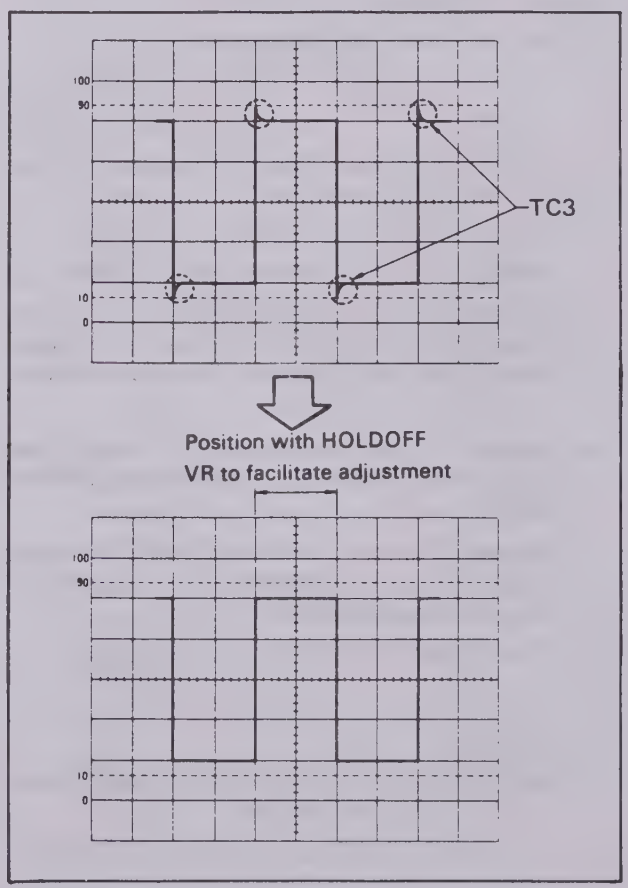


Fig. 41. Auto Focus Waveform Adjustment.

7. Repeat "Astigmatism" adjustment with A INTENSITY control at 3 o'clock position. Adjust VR9 and FOCUS knob so optimum focus is achieved at about center of FOCUS control adjustment range (12 o'clock position of FOCUS knob). The spot should be positioned near the center of the screen for this adjustment.

Trace Rotation

1. Select CH 1 vertical mode, A horizontal mode, and AUTO trigger mode.
2. Vertically center the trace on the CRT.
3. Adjust VR2 so trace is exactly parallel with center horizontal line on graticule scale.

Perpendicularity (Y Axis Rotation) and Pattern Distortion
(Model 1590 only)

1. Select X-Y horizontal mode.
2. GND channel 2 input (AC-GND-DC switch).
3. Select AC coupling of channel 1 input (AC-GND-DC switch).
4. Apply 1 kHz sine wave to CH 1 input. A vertical line will appear on the display.
5. Center the vertical line with CH 1 and CH 2 ▲▼ POSITION controls and adjust sine wave amplitude for 8 divisions vertical deflection.
6. Adjust VR3 so vertical line is exactly parallel with center vertical line on graticule scale.
7. Repeat "Trace Rotation" and "Perpendicularity" adjustments for minimum interaction, if required.
8. Check pattern distortion as follows:
   a. Apply a 100 kHz sine wave to CH 1 input.
   b. Select AC coupling of channel 2 input (AC-GND-DC switch).
   c. Apply a 1 kHz sine wave to CH 2 input.
   d. Adjust sine wave generator outputs to produce a square of 8 divisions per side (Fig. 42).
   e. Adjust VR10 so that the horizontal and vertical distortion is minimum; it must be less than 0.2 division (dimension "d" in Fig. 42).

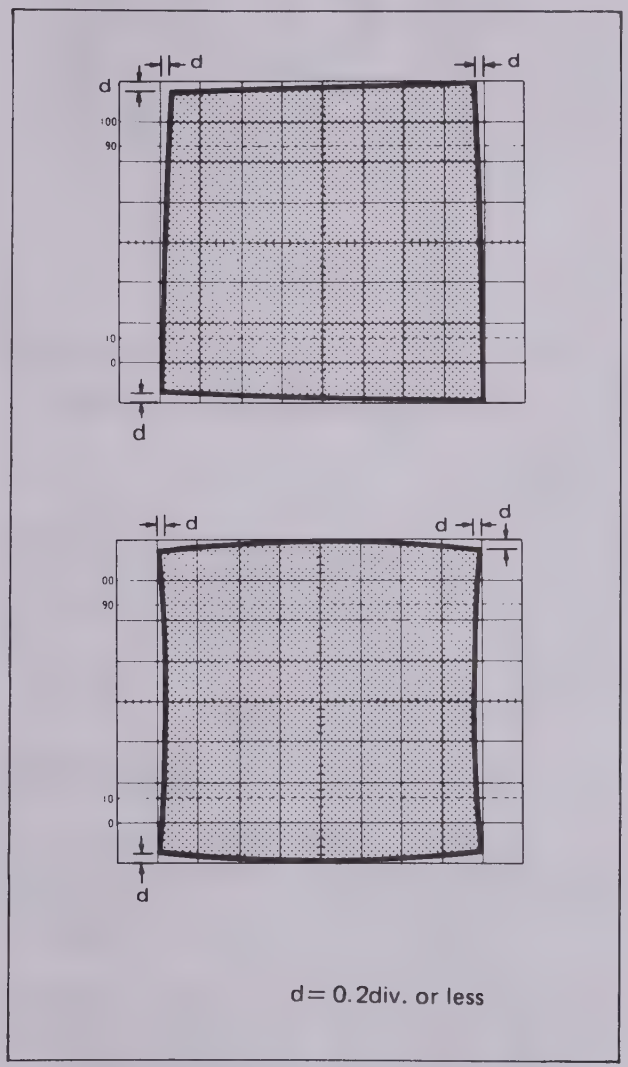


Fig. 42. Pattern Distortion Check. (Model 1590 Only)

VERTICAL AXIS ADJUSTMENTS

Centering

1. Select CH 1 vertical mode, A horizontal mode, and AUTO trigger mode.
2. GND channel 1 input (AC-GND-DC switch).

3. Short together the "TP" test points on vertical preamplifier board X73-1320.
4. Adjust VR1 (vertical output amplifier board X73-1330) to vertically center trace on the CRT.
5. Remove short from "TP" test points on vertical preamplifier board.

DC Balance

1. Channel 1.
   a. Repeat steps 1 and 2 of "Centering" adjustment.
   b. Rotate CH 1 VARIABLE control back and forth.
   c. Adjust VR1 (on vertical attenuator board X75-1120) for zero or minimum vertical shift of trace as VARIABLE control is rotated. Trace should move less than 0.2 div.
   d. On Model 1590, check that CH 1 UNCAL lamp is on whenever CH 1 VARIABLE control is not at CAL.
2. Channel 2.
   a. Select CH 2 vertical mode.
   b. GND channel 2 input.
   c. Rotate CH 2 VARIABLE control back and forth.
   d. Adjust VR2 (on vertical attenuator board X75-1120) for zero or minimum vertical shift of trace as VARIABLE control is rotated. Trace should move less than 0.2 div.
   e. On Model 1590, check that CH 2 UNCAL lamp is on whenever CH 2 VARIABLE control is not at CAL.

Channel 1 and 2 Gain

1. Select CH 1 vertical mode, A horizontal mode, and AUTO trigger mode.
2. Select V. MODE trigger source and AC trigger coupling.
3. Turn on 20 MHz BW switch.
4. For channel 1 and 2, select DC coupling of input and 5 mV/div sensitivity. Set VARIABLE controls to CAL position.
5. On Model 1590 only, be sure 50Ω termination is off and UNCAL lamps are off.
6. Apply calibrated 20 mV peak-to-peak 1 kHz square wave to CH 1 and CH 2 inputs.
7. Adjust VR3 (on vertical preamp board X73-1320) for exactly 4 divisions of channel 1 signal.
8. Select DUAL/ALT vertical mode and adjust VR13 so channel 2 waveform is also exactly 4 divisions amplitude.
9. Switch vertical mode to ADD and A TRIG SOURCE to CH 1 and press CH 2 INV pushbutton (lamp on). This subtracts the channel 1 and 2 waveforms. If the waveforms are exactly the same amplitude, they should cancel and leave only a straight line. Set ▲▼ POSITION controls to locate the trace in the center of the CRT. If a straight line cannot be obtained (channel 1 and 2 signals not fully cancelled), slightly readjust VR13.

Channel 1 and 2 Position

1. Select DUAL/ALT vertical mode, and 0.1 ms/div sweep time. Turn on the 20 MHz BW switch. Turn off CH 2 INV.
2. GND channel 1 and 2 inputs and select 5 mV/div sensitivity for both channels.
3. Set channel 1 and channel 2 ▲▼ POSITION controls to their mechanical centers (12 o'clock position).
4. Adjust VR4 and VR14 (on vertical preamp board X73-1320) so both traces are superimposed in exact vertical center of screen.
5. Rotate ▲▼ POSITION controls for both channel 1 and 2 to fully clockwise position. Both traces must move up at least 4 divisions.
6. Rotate ▲▼ POSITION controls for both channel 1 and 2 to fully counterclockwise position. Both traces must move at least 4 divisions below center line.
7. Alternately select and release CH 2 INV function.
8. Adjust VR15 (on vertical preamp board X73-1320) so channel 2 trace does not shift when CH 2 INV function is selected.

x5 Gain

1. Set controls as for "Channel 1 and 2 Gain" adjustment (steps 1 thru 5).
2. Select DUAL/ALT vertical mode and apply calibrated 5 mV p-p 1 kHz square wave to CH 1 and CH 2 inputs.
3. Pull X5 GAIN knobs for channel 1 and 2.
4. For Model 1590, check that X5 GAIN indicators light.
5. Adjust VR6 and VR17 (on vertical preamp board X73-1320) so both waveforms are exactly 5 divisions amplitude on display.
6. Select ADD mode and CH 2 INV. Readjust VR17 for maximum cancellation of waveforms.

If waveform(s) disappear when X5 GAIN is selected, a coarse adjustment of VR5 and VR16 may first be required to bring waveforms onto viewing area of screen (see following "x5 Position" adjustment procedure).

In 5 mV/div and X5 GAIN settings, the trace may widen and make precision adjustment more difficult. Selecting the 20 MHz BW function may provide a finer trace.

X5 Position

1. Set controls as for "Channel 1 and 2 Position" adjustment (steps 1 thru 3). Make sure CH 1 and CH 2 POSITION controls are still mechanically centered.
2. Pull X5 GAIN knobs for channel 1 and 2. Be careful not to rotate POSITION settings.
3. Adjust VR5 and VR16 (on vertical preamp board X73-1320) to superimpose both traces in the exact vertical center of the screen.

Channel 3 and 4 Gain

1. Set up oscilloscope as follows:
   a. QUAD/ALT vertical mode.
   b. A horizontal mode.
   c. AUTO trigger mode.
   d. A SOURCE switch to EXT CH 3 (CH 3 1/1 for Model 1590).
   e. B SOURCE switch to EXT CH 4 (CH 4 1/1 for Model 1590).
   f. A and B SWEEP TIME to 0.2 ms/div.
   g. A and B INTENSITY to 3 o'clock.
   h. CH1 and CH2 AC-GND-DC to GND.
2. Apply calibrated 0.5 volt p-p, 1 kHz square wave to CH 3 and CH 4 inputs.
3. Adjust CH 3 and CH 4 POSITION controls to superimpose both square wave signals in the center of the screen.
4. Adjust VR11 and VR21 (on vertical preamp board X73-1320) for exactly 5 divisions amplitude for channel 3 and channel 4 respectively.
5. (This step applies to Model 1590 only) Check calibration accuracy of channel 3 and 4 at 10:1 attenuation.
   a. Set A SOURCE switch to CH 3 1/10.
   b. Set B SOURCE switch to CH 4 1/10.
   c. Apply calibrated 5-volt peak-to-peak, 1 kHz square wave to CH 3 and CH 4 inputs.
   d. Displayed waveforms should be 5 divisions ±3% (±0.15 division).

Channel 3 and 4 Position

1. Perform "Channel 1 and 2 Position" adjustment procedure.
2. Select QUAD/ALT vertical mode.
3. Ground the CH 3 and CH 4 input jacks.
4. Set CH 3 and CH 4 POSITION controls to the center of their mechanical rotation.
5. Adjust VR3 and VR4 (on horizontal mode control assembly X77-1130) to superimpose channel 3 and 4 trace exactly over channel 1 and 2 trace at center of screen.

DC Trigger Levels

1. IMPORTANT: Recheck "DC Balance" and readjust if required.
2. Select QUAD/ALT vertical mode, A horizontal mode, and AUTO trigger mode.

3. GND channel 1 and 2 inputs (AC-GND-DC switches) and channel 3 and 4 inputs (at CH 3 and CH 4 input jacks).
4. Set CH 1, 2, 3, and 4 POSITION controls to superimpose all four traces at the vertical center of the screen.
5. Measure the dc trigger level of each channel as follows:
   a. Use an accurate (1%) dc voltmeter with 100 mV scale.
   b. Construct meter probe of shielded cable terminated in plug that mates with trigger output connectors on the vertical preamp board (Fig. 43).

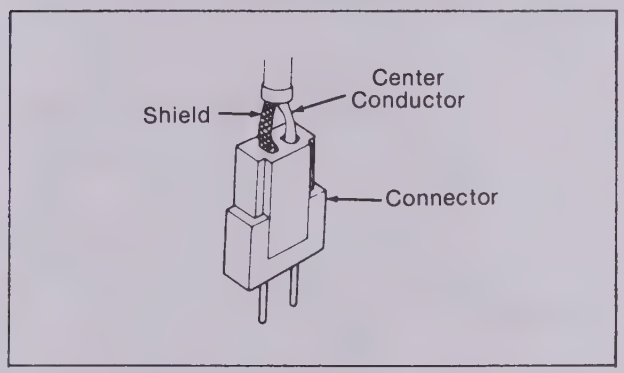


Fig. 43. Meter Probe for DC Trigger Level Adjustment.

   c. Adjust each dc trigger level for 0 volt ±0.008 volt (±8 mV) dc.

Channel	Connector	Adjust
1	P15	VR7
2	P16	VR19
3	P17	VR10
4	P18	VR20

6. Select CH1 vertical mode and set channel 1 sensitivity to 50 mV/div.
7. Measure voltage at P19 and adjust VR22 for 0 volt ±0.0008 volt.

External Channel 1 Output

1. Select CH 1 vertical mode, A horizontal mode, and AUTO trigger mode.
2. Use AC coupling and 5 mV sensitivity for channel 1.
3. Apply calibrated 20 mV p-p 1 kHz square wave to channel 1 input. The displayed waveform should be 4 divisions in amplitude.
4. Connect the output of the CH 1 OUT jack on the rear panel to a second calibrated oscilloscope (Model 1590 or 1570 or equivalent). Terminate in 50Ω. Set second oscilloscope AC-GND-DC switch to DC.
5. Adjust VR8 (on vertical preamp board X73-1320) for 200 mV p-p output as measured on second oscilloscope.
6. GND channel 1 input and center trace with channel 1 ▲▼ POSITION control (disconnect second oscilloscope).
7. Measure dc voltage at CH 1 OUT jack (or P21, pin 1 and 2) with accurate 100 mV range dc voltmeter.
8. Adjust VR9 (on vertical preamp board X73-1320) for 0 volt ±10 mV.

Vertical Attenuator

Calibration of the vertical attenuators (including "Input Capacitance" and "Attenuator Frequency Compensation" adjustments) must be made with the attenuator shield covers in place. For proper adjustment, a temporary shield with holes drilled for access to trimmers should be installed during calibration. After calibration, the standard shield covers should be replaced. Use a non-metallic tuning tool for making adjustments.

Input Capacitance

The purpose of this procedure is to equalize the input capacitance for all ranges of the vertical attenuator. This is accomplished by using the input capacitance of the 5 mV/div range as reference and adjusting other ranges to match.

This procedure requires the network shown in Fig. 44. This network is essentially a 2:1 divider network, since the 1 MΩ resistance of the network and the 1 MΩ input resistance of the vertical attenuator form a voltage divider. A 10:1 probe could also be used, except that a square wave of at least 25 volts p-p (not commonly available) would be required for adjustment of the 0.5 V/div attenuator setting. Adjustments must be performed in the listed sequence for minimum interaction.

1. Set up oscilloscope as follows:
   a. 20 MHz BW off.
   b. CH 2 INV off.
   c. CH 1 vertical mode.
   d. A horizontal mode.
   e. AUTO trigger mode.
   f. CH 1 trigger source.
   g. AC trigger coupling.
   h. A trigger slope (-).
   i. Channel 1 and 2 sensitivity 5 mV/div.
   j. AC coupling of channel 1 and 2 input.
2. Connect the 2:1 divider network (Fig. 44) between a square wave generator and the CH 1 input of the oscilloscope. Use the 1 MΩ oscilloscope input termination (not 50 Ω) for this procedure.
3. Set the CH 1 VOLTS/DIV control to 5 mV and apply sufficient 1 kHz square wave for 5 divisions amplitude. Set sweep time for one or two cycles of displayed square wave.
4. Adjust the external trimmer capacitor of the 2:1 divider network for the most ideal square wave characteristic, as shown in Fig. 45. The external trimmer capacitor should not be readjusted after this step.
5. Set the CH 1 VOLTS/DIV control to each of the settings of Table 5. For each setting, adjust the signal generator output to display a square wave of 5 divisions amplitude. Adjust the corresponding trimmer (listed in Table 5) so the display matches the reference square wave characterisitic of step 4.
6. Change oscilloscope control settings to view CH 2 waveform and apply square wave from 2:1 divider network to CH 2 input. Repeat procedure for CH 2, adjusting the appropriate trimmers listed in Table 5.
7. Change oscilloscope control settings to view CH 3 and CH 4 waveforms and apply square wave from 2:1 divider network to CH 3, then CH 4. Repeat procedure for CH 3 and CH 4, adjusting the appropriate trimmers listed in Table 5 and using the channel 1 waveform for reference.

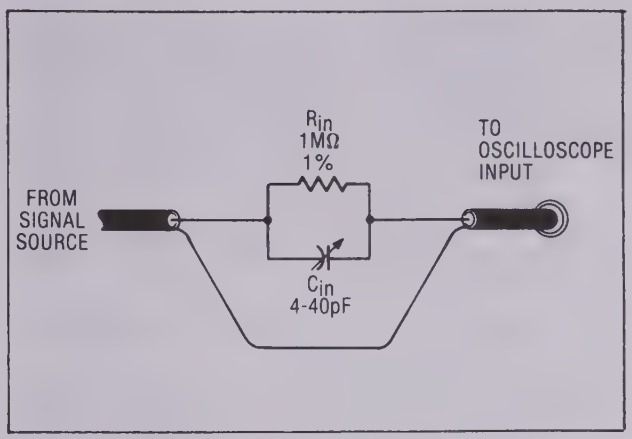


Fig. 44. 2:1 Divider Network for Input Capacitance Adjustment.

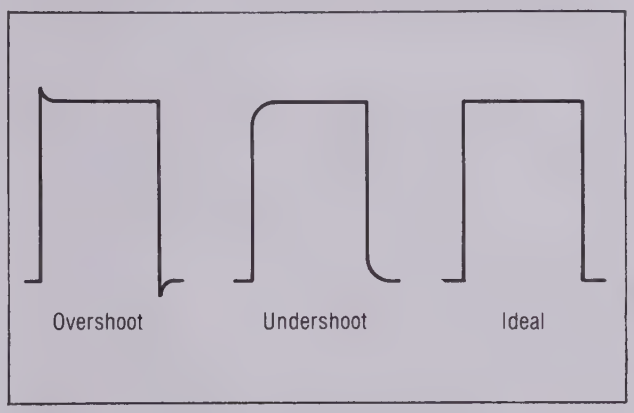


Fig. 45. 1 kHz Square Wave Characteristic.

Attenuator Frequency Compensation

The object of this procedure is to obtain the same frequency response for all ranges of the vertical attenuator. A 1 kHz square wave signal is applied directly to the oscilloscope (not thru the 2:1 divider network of Fig. 44) and terminated into 50 Ω, using the 5 mV/div range for reference. The leading edge of the displayed square wave is adjusted to match the reference waveform for other ranges of the attenuator. Adjustments must be performed in the specified sequence for minimum interaction.

1. Set up the oscilloscope the same as in step 1 of the "Input Capacitance" adjustment procedure.
2. Select sweep time of 0.2 ms/div.
3. Apply 1 kHz square wave (terminated in 50Ω) to channel 1 input.

Generator Output	Scope Input	Attenuator Sensitivity	Adjust
Channel 1 and 2 adjustments are located on vertical attenuator board X75-1120.			
CHANNEL 1			
50 mV	25 mV	5 mV/div	Reference
100 mV	50 mV	10 mV/div	TC1
200 mV	100 mV	20 mV/div	TC2
500 mV	250 mV	50 mV/div	TC3
5 V	2.5 V	0.5 V/div	TC8
CHANNEL 2			
50 mV	25 mV	5 mV/div	Reference
100 mV	50 mV	10 mV/div	TC12
200 mV	100 mV	20 mV/div	TC13
500 mV	250 mV	50 mV/div	TC14
5 V	2.5 V	0.5 V/div	TC19
Channel 3 and 4 adjustments are located on horiz. mode control board X77-1130.			
CHANNEL 3			
1 V	0.5 V	1/1	TC1
10 V *	5 V *	1/10 *	TC2 *
CHANNEL 4			
1 V	0.5 V	1/1	TC4
10 V *	5 V *	1/10 *	TC5 *
* = Model 1590 only.			

Table 5. Input Capacitance Adjustments.

Input Amplitude	Attenuator Sensitivity	Adjust
Channel 1 and 2 adjustments are located on vertical attenuator board X75-1120.		
CHANNEL 1		
25 mV	5 mV/div	Reference
50 mV	10 mV/div	TC4
100 mV	20 mV/div	TC5
250 mV	50 mV/div	TC6
2.5 V	0.5 V/div	TC10, TC7, TC23
CHANNEL 2		
25 mV	5 mV/div	Reference
50 mV	10 mV/div	TC15
100 mV	20 mV/div	TC16
250 mV	50 mV/div	TC17
2.5 V	0.5 V/div	TC21, TC18, TC24
Channel 3 and 4 adjustments apply to Model 1590 only and are located on horizontal mode control board X77-1130.		
CHANNEL 3		
5 V	1/10	TC3, TC7
CHANNEL 4		
5 V	1/10	TC6, VR5

Table 6. Attenuator Frequency Compensation Adjustments.

NOTE

After completing "Attenuator Frequency Compensation" adjustments, recheck "Input Capacitance" for interaction. If required, repeat "Input Capacitance" and "Attenuator Frequency Response" adjustments to eliminate interaction.

4. For each step of attenuation listed in Table 6, perform the following procedure:
   a. Apply sufficient amplitude square wave for 5 divisions amplitude on the CRT.
   b. Adjust the corresponding trimmer for the same square wave characteristic as obtained in the 5 mV/div reference step.
5. Change oscilloscope control settings to view CH 2 waveform and apply 1 kHz square wave to CH 2 input. Repeat procedure for CH 2, adjusting appropriate trimmers listed in Table 6.
6. For Model 1590 only, change oscilloscope control settings to view CH 3 and CH 4 waveforms and apply 1 kHz square wave to CH 3, then CH 4. Repeat procedure for CH 3 and CH 4, adjusting appropriate trimmers listed in Table 6.

Vertical Amplifier Frequency Compensation

These adjustments of the vertical preamplifier and vertical output amplifier extend the -3 dB bandwidth to at least 100 MHz for Model 1590, and to at least 70 MHz for Model 1570. Proper adjustment is critical to accuracy and non-distorted display at high frequencies. The best results can be obtained by alternately using a combination of two methods. The first is by observing the leading edge of a fast rise time 1 MHz square wave and adjusting for the best waveshape. The second is by observing the frequency response using a sweep generator with a flat response from 1 kHz to at least 120 MHz for Model 1590, at least 90 MHz for Model 1570. Since adjustments tend to interact to some degree, it is advisable to repeat the procedure until no improvement can be obtained, typically three times.

Channel 1

1. Set up oscilloscope as follows:
   a. 20 MHz BW off.
   b. CH 2 INV off.
   c. CH 1 vertical mode.
   d. A horizontal mode.
   e. AUTO trigger mode.
   f. CH 1 trigger source.
   g. AC trigger coupling.
   h. A trigger slope (-).
   i. Channel 1 and 2 sensitivity 5 mV/div.
   j. DC coupling of channel 1 and 2 input.
2. Apply 1 MHz square wave with fast rise time to channel 1 input. Terminate in 50Ω (for Model 1590 use the PUSH 50Ω switch, for Model 1570 use an external 50Ω termination). Set amplitude of square wave generator for 6 divisions p-p vertical deflection on screen.
3. Adjust sweep speed to display one cycle of waveform or less, and so positive-going edge is in approximate center of screen.
4. Adjust the trimmer capacitors in the sequence listed in Table 7 for best square wave characteristic, as shown in Fig. 46. However, do not completely eliminate overshoot, as high frequency response will be degraded.
5. Recheck channel 1 square wave characteristics at 100 kHz, 10 kHz, and 1 kHz. Repeat adjustments if required for best overall characteristics at all frequencies.
6. Disconnect square wave generator and connect rf output of sweep generator to CH 1 input. Set generator to sweep from 1 kHz to at least 120 MHz for Model 1590, at least 90 MHz for Model 1570, with frequency markers each 10 MHz. A display similar to Fig. 47 (Model 1590) or Fig. 48 (Model 1570) should be displayed. Set sweep generator amplitude for 6 divisions vertical display at lower frequencies. Repeat adjustments of Table 7 for flattest frequency response without dips or peaks, and which rolls off smoothly. There must be at least 4.2 divisions amplitude at 100 MHz for Model 1590, at least 4.2 divisions amplitude at 70 MHz for Model 1570.
7. Repeat steps 2 thru 6 to reduce interaction and obtain best overall response, typically three times.

ADJUST	LOCATION
TC3	vert output amp X73-1330.
TC1	vert preamp X73-1320.
TC10	vert preamp X73-1320.
TC11	vert attenuator X75-1120.
TC1	vert output amp X73-1330.

Table 7. CH 1 Frequency Response.

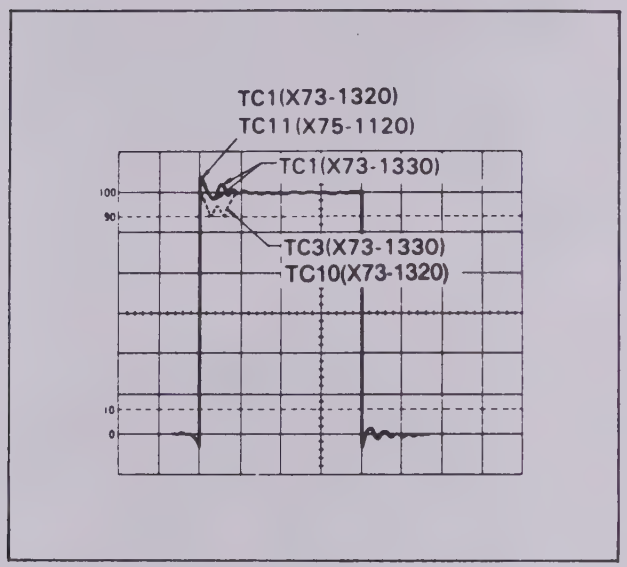


Fig. 46. Channel 1
Square Wave Compensation.

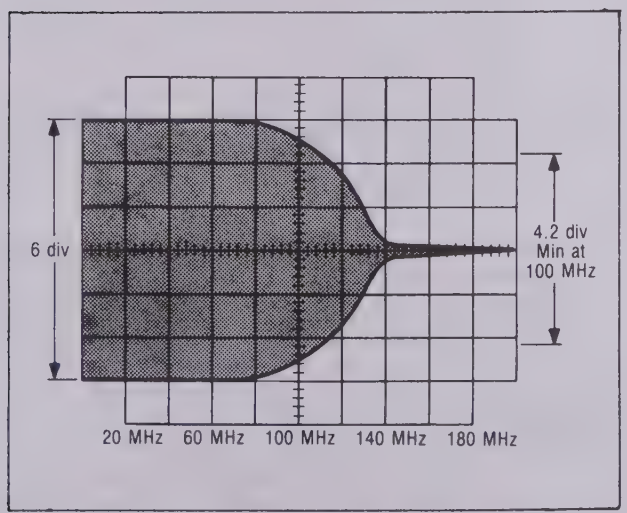


Fig. 47. Desired Frequency Response Display,
Model 1590.

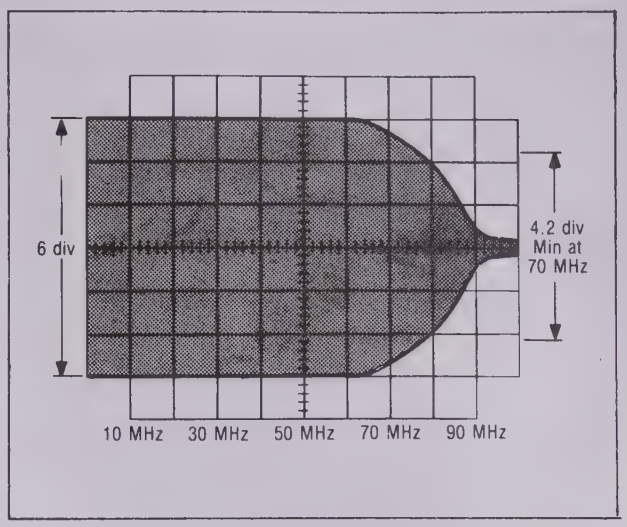


Fig. 48. Desired Frequency Response Display,
Model 1570.

Channel 2

1. Apply the 50Ω terminated 1 MHz square wave to channel 2 input. Select the CH 2 vertical mode and CH 2 trigger source.
2. Adjust the trimmer capacitors in the sequence listed in Table 8 for the best square wave characteristic as shown in Fig. 49.
3. Recheck channel 2 square wave characteristics at 100 kHz, 10 kHz, and 1 kHz. Repeat step 2 adjustments if required for best overall characteristics at all frequencies.
4. Disconnect square wave generator and connect rf output of sweep generator to both CH 1 and CH 2 inputs. Select DUAL trace mode and superimpose channel 2 trace directly over channel 1 trace. Readjust trimmers of Table 8 so channel 2 frequency response display matches channel 1 (Fig. 47 and 48).
5. Repeat steps 1 thru 4 to reduce interaction and obtain best overall response, typically three times.

ADJUST	LOCATION
TC5	vert preamp X73-1320.
TC22	vert attenuator X75-1120.
TC11	vert preamp X73-1320.

Table 8. CH 2 Frequency Response.

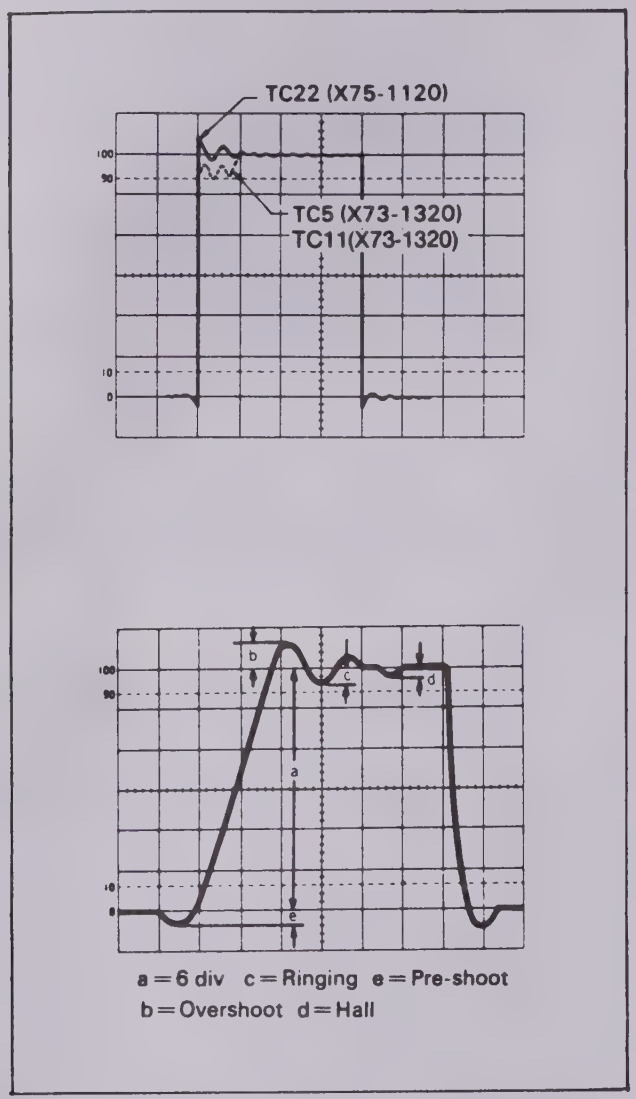


Fig. 49. Channel 2
Square Wave Compensation.

x5 Gain

1. Immediately after performing the channel 1 and channel 2 frequency response adjustments, pull the channel 1 and 2 PULL X5 GAIN knobs and reduce square wave input for 5 divisions amplitude on display.
2. Select CH 1 vertical mode and CH 1 trigger source (1 MHz square wave applied to channel 1 input) and adjust TC2 on vertical preamp board X73-1320 for best waveform characteristics. Overshoot must not exceed 8% (about 0.5 division).
3. Select CH 2 vertical mode and CH 2 trigger source (square wave applied to channel 2 input) and adjust TC6 on vertical preamp board X73-1320 for best square wave characteristic. Again, overshoot should not exceed 8%.
4. Apply sweep generator and check frequency response (Fig. 47 and 48). Repeat adjustments if required.

Channel 1 Output

1. Connect second oscilloscope (calibrated Model 1590 or 1570 or equivalent) to the CH 1 output jack. Adjust TC9 on vertical preamp board X73-1320 for best waveshape of square wave on second oscilloscope.

Channel 3

1. Set up oscilloscope as for "Channel 3 and 4 Gain" adjustments.
2. Set A SOURCE switch to EXT CH 3 (CH 3 1/1 for Model 1590).
3. Apply 1 MHz square wave to channel 3 input. Terminate in 50Ω. Set amplitude of square wave generator for 6 division p-p vertical deflection on screen.
4. Adjust sweep speed to display one cycle of waveform or less, and so positive-going edge is in approximate center of screen.
5. Adjust TC4 and TC3 on vertical preamp board X73-1320 for best square wave characteristic (Fig. 50).
6. Recheck channel 3 square wave characteristic at 100 kHz, 10 kHz, and 1 kHz. Repeat adjustment if required for best overall characteristics at all frequencies.
7. Apply sweep generator and check frequency response. Repeat adjustment if required for same frequency response as obtained for channel 1 and 2 (Fig. 47 and 48).

Channel 4

1. Set up oscilloscope as for "Channel 3 and 4 Gain" adjustments.
2. Select B DLY'D mode of horizontal display and set B SOURCE switch to EXT CH 4 (CH 4 1/1 for Model 1590).

3. Apply 1 MHz square wave to channel 4 input. Terminate in 50Ω. Set amplitude of square wave generator for 6 division p-p vertical deflection on screen.
4. Adjust B sweep speed to display one cycle of waveform or less, and so positive-going edge is in approximate center of screen.
5. Adjust TC8 and TC7 on vertical preamp board X73-1320 for best square wave characteristic (Fig. 50).
6. Recheck channel 4 square wave characteristic at 100 kHz, 10 kHz, and 1 kHz. Repeat adjustment if required for best overall characteristics at all frequencies.
7. Apply sweep generator and check frequency response. Repeat adjustment if required for same frequency response as obtained for channel 1 and 2 (Fig. 47 and 48).

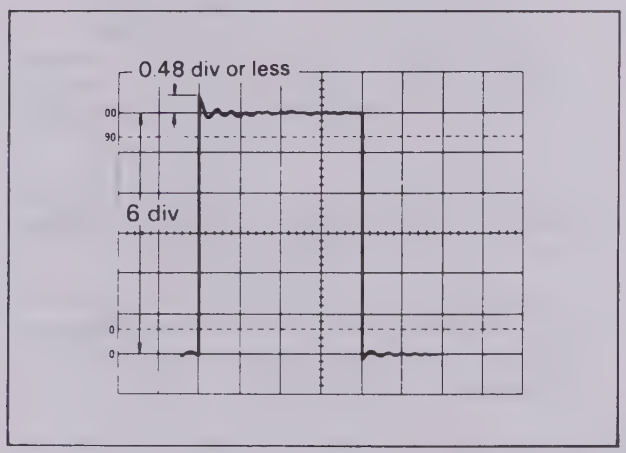


Fig. 50. Channel 3 and 4 Square Wave Characteristics.

SWEEP ADJUSTMENTS

All adjustments made at sweep speeds of 1 µs/div and faster should be performed with the oscilloscope case in place. To calibrate the instrument, a case with holes drilled for access to trimmers should be temporarily installed. The standard case should be replaced at the end of calibration.

Oscilloscope Set-Up

At the beginning of each sweep adjustment procedure, the front panel controls should be set as follows. Any variation from these settings is given in each adjustment procedure.

a. CH 1 vertical mode.
b. A horizontal mode.
c. AUTO trigger mode.
d. AC coupling of channel 1 input.
e. A TRIGGER SOURCE to V. MODE.
f. B TRIGGER SOURCE to CH 1.
g. A and B trigger COUPLING to AC.
h. A and B SLOPE switches to (+).
i. A and B LEVEL control centered (12 o'clock), PULL FIX off, and PULL-STARTS AFTER DELAY off.
j. HOLDOFF control to NORM.
k. TRACE SEPARATION minimum.
l. DELAY TIME MULTIPLIER to 0.
m. Sweep time vernier (A VAR.) to CAL position.
n. A INTENSITY and B INTENSITY to 3 o'clock position.

Coarse Adjustment of A and B Trigger Center and Slope

1. Set A and B SWEEP TIME to 0.2 ms/div.
2. Apply 1 kHz sine wave or triangle wave to channel 1 input and adjust vertical POSITION controls for 3 divisions above and 3 divisions below center horizontal line on graticule scale. Adjust the horizontal POSITION control so the starting point of the waveform is visible.
3. Alternately switch A SLOPE switch between (+) and (-) positions. Adjust VR2 on A trigger switch assembly X77-1110 so waveform starting point is at exact vertical center of display, regardless of whether (+) or (-) slope is selected. The A LEVEL control must remain centered throughout this step.
4. Offset A LEVEL control from center. Continue to alternately switch A SLOPE between (+) and (-). Adjust VR3 on A trigger switch assembly X77-1110 so waveform starting point is symmetrical vertical distance from center as SLOPE is switched from (+) to (-) (Fig. 51).

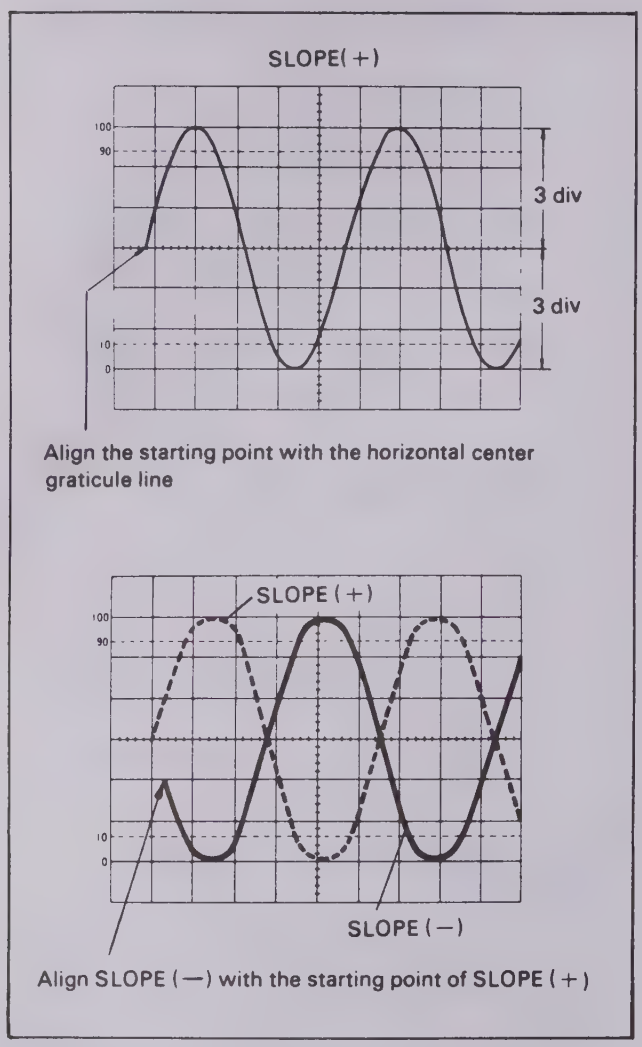


Fig. 51. A & B Trigger Slope Adjustment.

5. Recheck steps 3 and 4, and readjust if required.
6. Repeat procedure for B trigger as follows:
   a. Change oscilloscope set-up as follows:
      (1) Select ALT horizontal mode.
      (2) Set A INTENSITY control to minimum.
   b. The displayed 1 kHz sine wave or triangle wave is now the B sweep.
   c. Alternately switch B SLOPE switch between (+) and (-) positions. Adjust VR2 on B trigger switch assembly X77-1120 so waveform starting point is at exact vertical center of display, regardless of whether (+) or (-) slope is selected. The B LEVEL control must remain centered throughout this step.
   d. Offset B LEVEL control from center. Continue to alternately switch B SLOPE between (+) and (-). Adjust VR3 on B trigger switch assembly X77-1120 so waveform starting point is symmetrical vertical distance from center as B SLOPE is switched from (+) to (-) (Fig. 51).
   e. Recheck steps c and d, and readjust if required.

Sweep Time Calibration

1. Prepare oscilloscope as instructed in "Oscilloscope Set-Up" procedure.
2. Set A and B SWEEP TIME to 0.5 ms/div and make sure sweep time A VAR. is set to CAL position.
3. Apply 0.5 ms time markers to channel 1 input. Adjust VR9 on trigger & sweep board X74-1320 so 10 markers span exactly 10 horizontal divisions on the display (Fig. 52).
4. Select ALT horizontal mode and use TRACE SEPARATION control to display two sets of time markers (Fig. 53).
5. Adjust VR10 on trigger & sweep board X74-1320 so that 10 markers on B sweep display also span exactly 10 divisions (Fig. 53).

Sweep Length

1. Leave scope set up with two sets of time markers displayed as at the end of the "Sweep Time Calibration" procedure.
2. Adjust VR7 and VR8 on trigger & sweep board X74-1320 for sweep length of 11 to 11-1/2 divisions for sweep A and sweep B respectively (Fig. 54).
3. On Model 1590 only, make the following additional adjustment.
   a. Press and hold the BEAM FINDER switch.
   b. Adjust VR1 on horizontal output amplifier board X74-1230 for 6 divisions sweep length.

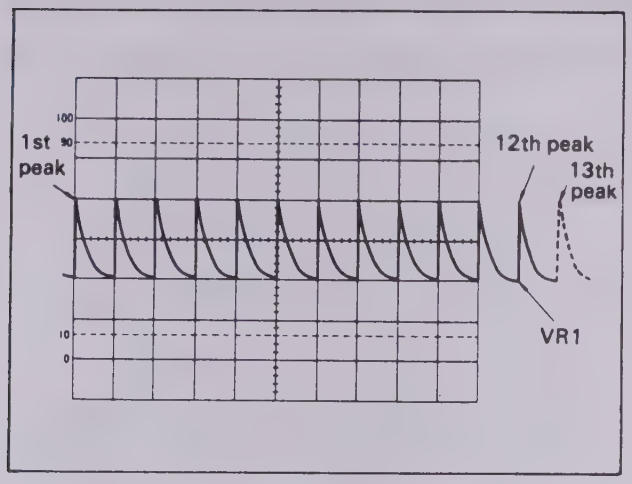


Fig. 52. "A" Sweep Time Adjustment.

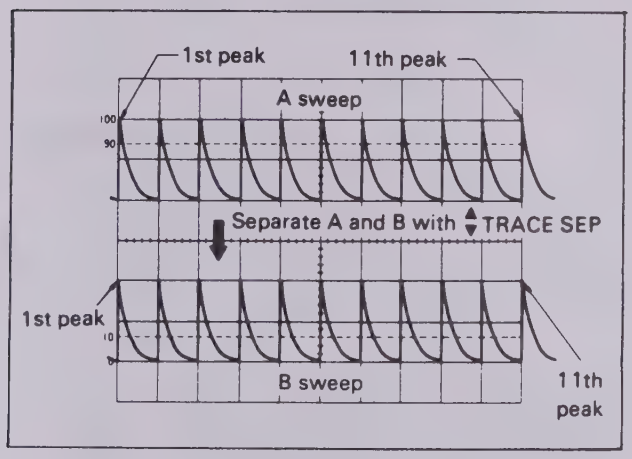


Fig. 53. "B" Sweep Time Adjustment.

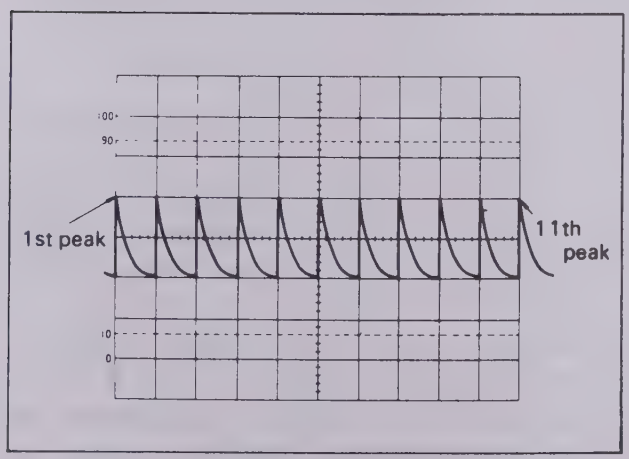


Fig. 54. Sweep Length Adjustment.

A Sweep Horizontal Position

1. Prepare oscilloscope as instructed in "Oscilloscope Set-Up" procedure.
2. Set A and B SWEEP TIME to 0.5 ms/div.
3. GND channel 1 input.
4. Set coarse horizontal POSITION control to its mechanical center (12 o'clock).
5. Rotate the FINE horizontal position control from one extreme to the other.
6. Adjust VR12 on trigger & sweep board X74-1320 so beginning of trace is equal number of divisions from left edge of screen (with POSITION control rotated fully counterclockwise) as the end of trace is from right edge of screen (with POSITION control rotated fully clockwise). Variation should be less than 1 division (Fig. 55)

B Sweep Horizontal Position

1. Perform "A Sweep Horizontal Position" adjustment.
2. Select ALT horizontal mode.
3. Unground CH 1 input and apply 0.5 ms time markers.
4. Adjust TRACE SEPARATION control for display of two sets of time markers.
5. Adjust VR11 on trigger & sweep board X74-1320 so horizontal position of time marks on B sweep corresponds to those on the A sweep.

x10 Magnification Adjustments

1. Set up oscilloscope as for "Sweep Time Calibration" and the A sweep time set to 0.1 ms/div. Apply 0.1 ms markers on the A sweep with an amplitude of about 2 divisions.
2. Adjust horizontal FINE position control so 1st and 11th markers exactly coincide with the extreme left and right lines on the graticule scale (Fig. 56).
3. Pull the PULL X10 MAG knob and adjust VR13 on trigger & sweep board X74-1320 so distance between 1st and 2nd markers is exactly 10 divisions (Fig. 56).

4. Adjust marker generator so three markers are displayed (without x10 magnification). Adjust the horizontal FINE position control to position the center marker at the center vertical line of the graticule scale (Fig. 57).
5. Alternately push and pull the PULL X10 MAG knob, being careful not to rotate the FINE position control. Adjust VR14 on trigger & sweep board X74-1320 so center marker is at same point on x10 scale as on x1 scale (Fig. 57).
6. Recheck x10 magnification gain and centering, and readjust if required.

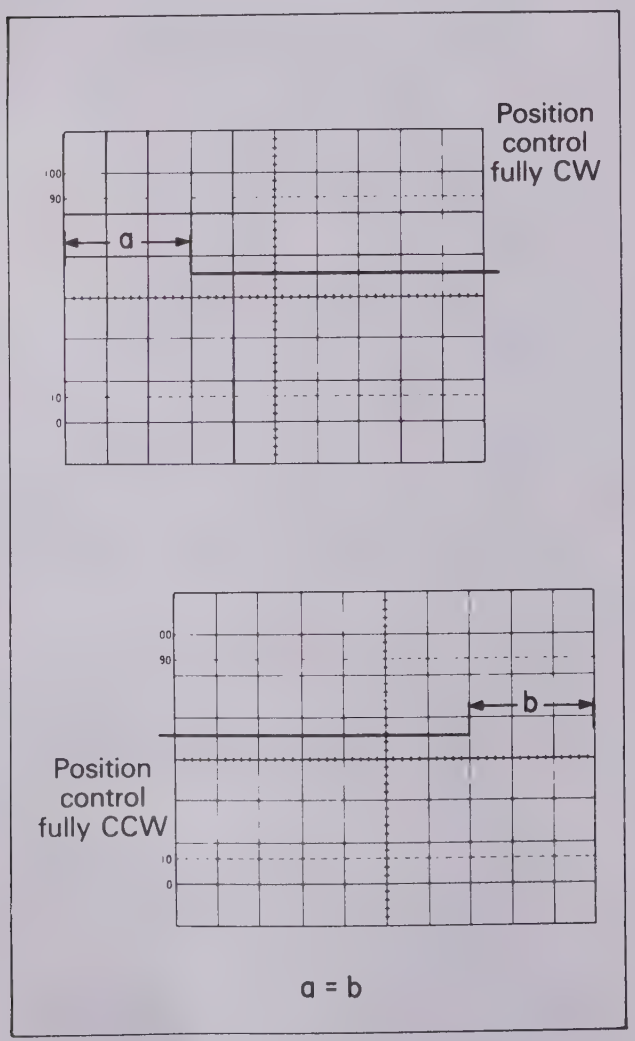


Fig. 55. Sweep Position Adjustment.

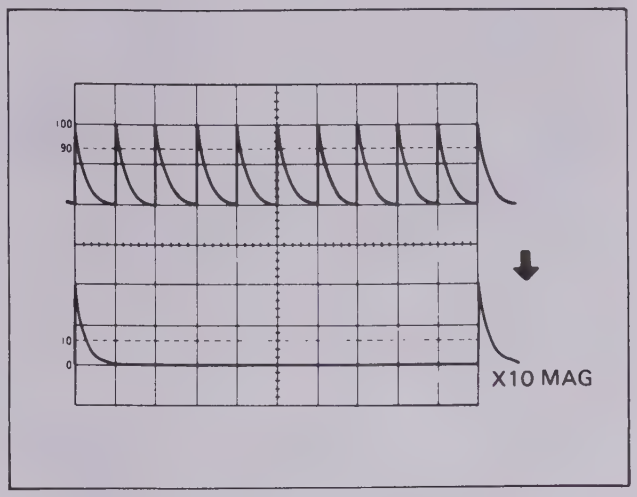


Fig. 56. X10 MAG Gain Adjustment.

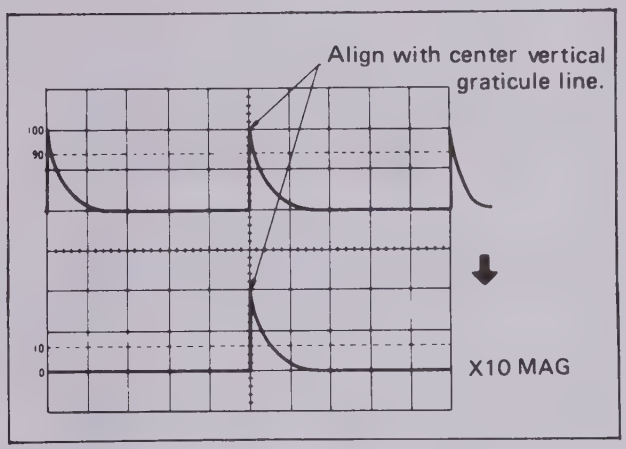


Fig. 57. X10 MAG Centering Adjustment.

50 ms, 5 µs, 0.1 µs Sweep Time

1. Prepare oscilloscope as instructed in "Oscilloscope Set-Up".
2. Perform the 50 ms/div, 5 µs/div, 0.1 µs/div adjustments in the sequence listed in Table 9. For each sweep time, perform the following steps.
   a. Set A and B SWEEP TIME control as instructed in Table 9.
   b. Apply time markers to channel 1 input as instructed in Table 9.
   c. Adjust corresponding A Sweep trimmer (see Table 9) on trigger & sweep board

X74-1320 so 10 markers exactly span 10 divisions on the display (Fig. 52).

d. Select ALT horizontal mode and adjust TRACE SEPARATION for two sets of time markers; A sweep and B sweep (Fig. 53).

e. Adjust corresponding B Sweep trimmer on trigger & sweep board X74-1320 so 10 markers on B sweep align with the 10 markers on A sweep.

SWEEP TIME	TIME MARKERS	A SWEEP ADJUST	B SWEEP ADJUST
50 ms	50 ms	VR2	VR4
5 µs	5 µs	VR1	VR3
0.1 µS	0.1 µS	TC1	TC2

Table 9. Sweep Time Adjustments.

Sweep Linearity

1. Prepare oscilloscope as instructed in "Oscilloscope Set-Up".
2. Select ALT horizontal mode and set A and B SWEEP TIME to fastest sweep time (0.02 µs/div for Model 1590 and 0.05 µs/div for Model 1570).
3. Apply 0.02 µs (Model 1590) or 0.05 µs (Model 1570) marker signal to channel 1 input and adjust TRACE SEPARATION so two sets of markers are displayed.
4. Adjust TC3 (for A sweep) and TC4 (for B sweep) on trigger & sweep board X74-1320 for best linearity; i.e., so all markers are exactly 1 division apart.

Sweep Time Check

Since some of the previous adjustments may interact, a final check of sweep time and linearity in all ranges should be performed.

1. Prepare oscilloscope as instructed in "Oscilloscope Setup".
2. Apply markers to channel 1 input. Set markers to same value as selected sweep speed.
3. Check that the A sweep time is ±3% of selected value. Repeat for each A sweep speed.
4. Select ALT horizontal mode and adjust TRACE SEPARATION control for two sets of time markers.
5. Check that each B sweep display matches A sweep display at each sweep speed.
6. Repeat adjustments as required to reduce interaction and obtain best overall accuracy and linearity.

X-Y ADJUSTMENTS

1. At the beginning of X-Y adjustment procedures, the front panel controls should be set as follows:
   a. DUAL/ALT vertical mode.
   b. 20 MHz BW off.
   c. CH 2 INV off.
   d. DC coupling of channel 1 and channel 2 input.
   e. Channel 1 and 2 sensitivity 5 mV/div, and VARIABLEs set to CAL. Do not pull X5 GAIN knobs.
   f. A horizontal mode.
   g. A SWEEP TIME to 0.1 ms/div.
   h. AUTO trigger mode.
   i. A TRIGGER SOURCE to CH 1.
2. X-Y Position Centering.
   a. Perform vertical and horizontal position calibration adjustments.
   b. Adjust CH 1 and CH 2 POSITION controls to superimpose both traces in the verical center of the screen.
   c. Select X-Y horizontal mode.
   d. Adjust VR15 on trigger & sweep board X74-1320 so spot is in horizontal center of screen.
   e. Turn channel 2 ▲▼ POSITION control fully counterclockwise and check that spot moves left more than 5 divisions.
   f. Turn channel 2 ▲▼ POSITION control fully clockwise and check that spot moves right more than 5 divisions from center.

3. X Gain.
   a. Select AC coupling of channel 2 input.
   b. Apply calibrated 20 mV p-p square wave to channel 2.
   c. Adjust VR18 on vertical preamp board X73-1320 for 4 divisions of horizontal deflection (may appear as two dots, 4 divisions apart).
4. Recheck centering and gain (steps 2 and 3), and readjust if required.
5. Check X axis frequency characteristics.
   a. DC coupling of channel 2 input.
   b. Apply a 1 kHz sine wave signal to channel 2 and adjust sine wave generator output level for 10 divisions horizontal deflection peak-to-peak.
   c. Increase frequency to 5 MHz without changing generator level. Amplitude must be at least 7.1 divisions horizontal deflection (-3 dB).

FINAL TRIGGER ADJUSTMENTS

1. Set front panel controls as for "Sweep Adjustments".
2. Set A and B SWEEP TIME to 0.2 ms/div.
3. Apply 1 kHz sine wave or triangle wave to channel 1 input and adjust for 3 divisions above and 3 divisions below center horizontal line on graticule scale. Adjust horizontal POSITION control as required to view the beginning of the trace.
4. Alternately switch A SLOPE between (+) and (-). Adjust VR3 on A trigger switch assembly X77-1110 so waveform starting point is symmetrical vertical distance from center as A SLOPE switch is switched from (+) to (-) (Fig. 58).
5. Check that when A SLOPE is in the (+) position, the waveform synchronizes on the rising slope, and when in the (-) position that the waveform synchronizes on the falling slope.
6. Adjust VR2 on A trigger switch assembly X77-1110 so waveform starting point is at exact vertical center of display, regardless of whether (+) or (-) slope is selected (Fig. 59). The A LEVEL control must remain centered throughout this step.
7. Alternately switch A SLOPE between (+) and (-) positons. Make sure starting point is always on the horizontal center graticule line (Fig. 60).
8. Check that A SLOPE switch is set to (+) position. Turn A LEVEL control clockwise toward 3 o'clock and counterclockwise toward 9 o'clock. Check that trigger level is as shown (Fig. 61).
9. Reduce the input signal to 1/2 division of vertical amplitude on the CRT. Check that the display can still be triggered. Check triggering by operation of the A TRIG'D indicator.
10. Repeat procedure for B trigger as follows:
    a. Change oscilloscope set-up as follows:
       (1) Select ALT horizontal mode.
       (2) Set A INTENSITY control to minimum.
       (3) The displayed 1 kHz sine wave or triangle wave is now the B sweep.
    b. Adjust VR3 on B trigger switch assembly X77-1120 so waveform starting point is symmetrical vertical distance from center as B SLOPE is switched from (+) to (-) (Fig. 58).
    c. Adjust VR2 on B trigger switch assembly X77-1120 so waveform starting point is at exact vertical center of display, regardless of whether (+) or (-) slope is selected (Fig. 59). The B LEVEL control must remain centered throughout this step.
    d. Alternately switch B SLOPE switch between (+) and (-) position. Make sure starting point is always on the horizontal center graticule line (Fig. 60).
    e. Check that B SLOPE is set to (+) position. Turn B LEVEL control clockwise toward 3 o'clock and counterclockwise toward 9 o'clock. Check that trigger level is as shown in Fig. 61.
11. Set A and B TRIG LEVEL controls to 12 o'clock position.

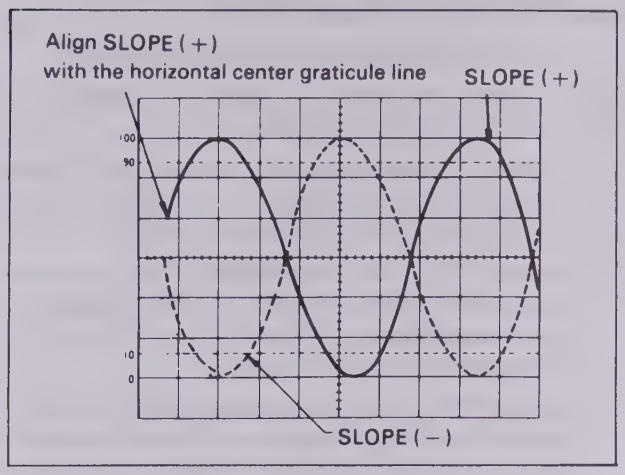


Fig. 58. "A" Trigger Slope Check.

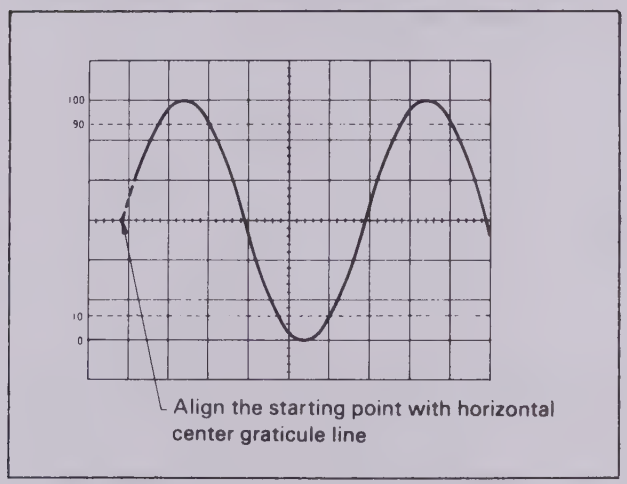


Fig. 59. "A" Waveform Centering.

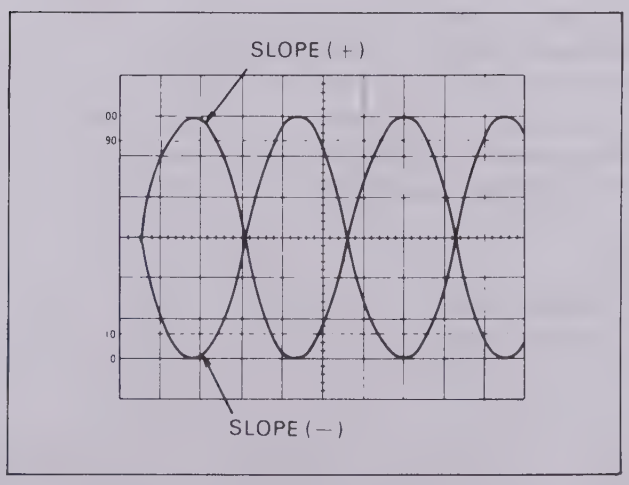


Fig. 60. "A" Trigger Level Check.

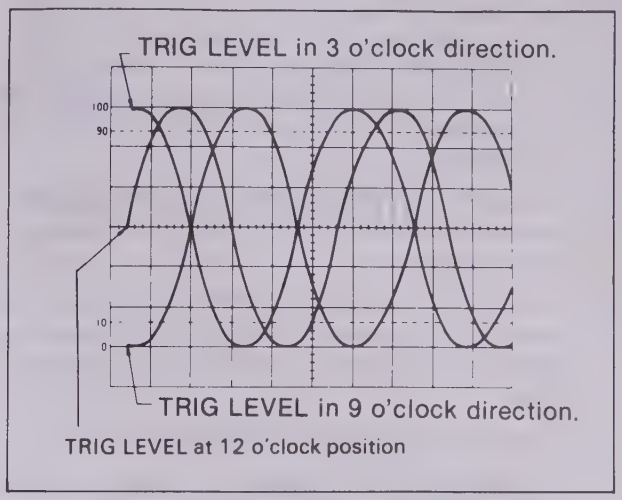


Fig. 61. "A" Trigger Level Variation.

12. Apply sufficient 100 MHz (Model 1590) or 70 MHz (Model 1570) sine wave to channel 1 input for 5 divisions vertical amplitude and adjust front panel controls for synchronized display of both sweeps.
13. Adjust TC1 on A trigger switch assembly X77-1110 so A sweep is triggered when amplitude of display is reduced to 1 division.
14. Adjust TC1 on B trigger switch assembly X77-1120 so B sweep is triggered when amplitude of display is reduced to 1 division.
15. Check that triggering sensitivity meets specifications for all trigger modes, trigger sources, and trigger coupling for both the A sweep and B sweep. Refer to the SPECIFICATIONS section of this manuals for minimum performance figures.

DELAY TIME MULTIPLIER

1. Set up oscilloscope as follows:
   a. CH 1 vertical mode.
   b. A-INT-B horizontal mode.
   c. AUTO trigger mode.
   d. A SWEEP TIME 0.1 ms/div.
   e. B SWEEP TIME 1 μs/div.

f. Select "Starts After Delay" operation; for Model 1590 pull out the PULL - STARTS AFTER DELAY knob, for Model 1570 set the B trigger SOURCE switch to the STARTS AFTER DELAY position.

2. Adjust A INTENSITY and B INTENSITY controls so intensified portion of sweep is readily visible.
3. Adjust horizontal POSITION control so start of A sweep trace exactly coincides with vertical line at left edge of graticule scale.
4. Set DELAY TIME MULTIPLIER to 0.20.
5. Adjust VR6 on trigger & sweep board X74-1320 so beginning of intensified area is 0.20 division to the right of the reference line in step 3 (Fig. 62).
6. Set DELAY TIME MULTIPLIER to 9.00.
7. Adjust VR5 on trigger & sweep board X74-1320 so beginning of intensified area exactly coincides with the 9th vertical line on the graticule scale (Fig. 63).
8. Recheck steps 4 thru 7 for any interaction and readjust if required.

CALIBRATION SQUARE WAVE

1. Perform vertical and sweep calibration.
2. Connect 1:1 probe to channel 1 input and touch to CAL terminal.
3. Display square wave on screen and make peak-to-peak voltage measurement and time measurement of square wave.
4. Adjust VR1 on horizontal mode control assembly X77-1130 for 0.3 volt peak-to-peak amplitude ±1% (if 10:1 probe is used, display will be 30 mV p-p).
5. Adjust VR2 on horizontal mode control assembly X77-1130 so one cycle of square wave equals 1 ms (10 divisions at sweep time of 0.1 ms/div). The square wave should be symmetrical; i.e., each half-cycle should equal 500 µs.

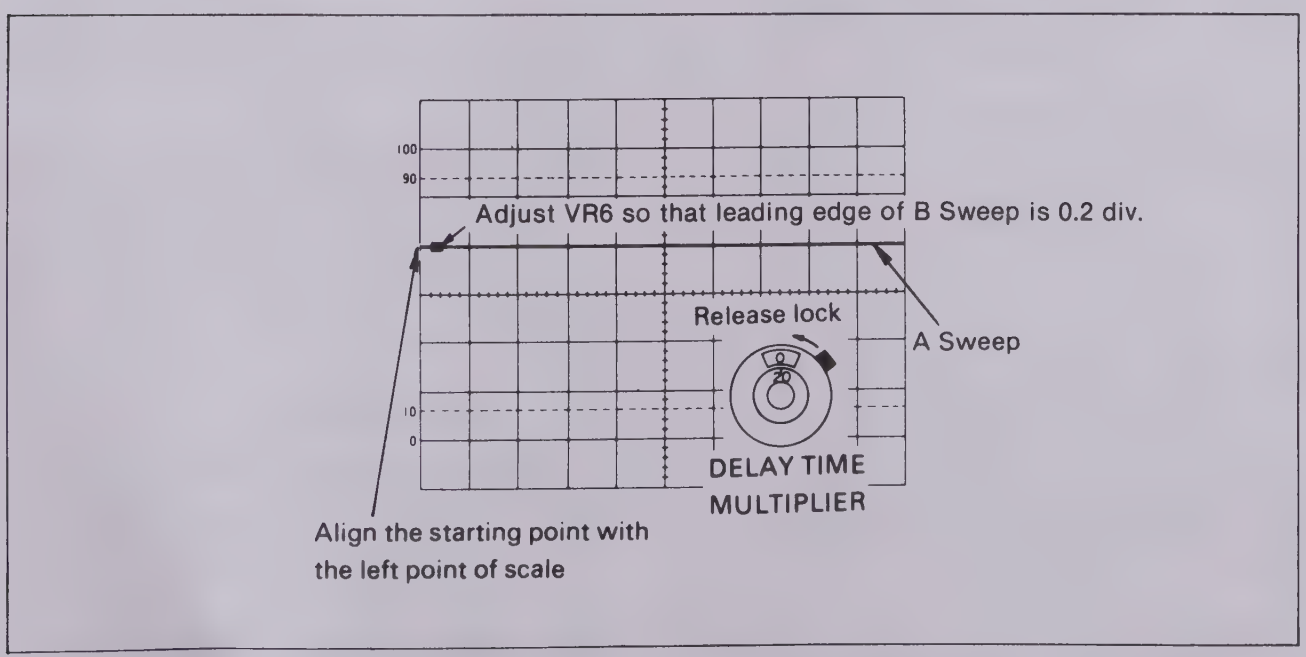


Fig. 62. Delay Check at 0.20.

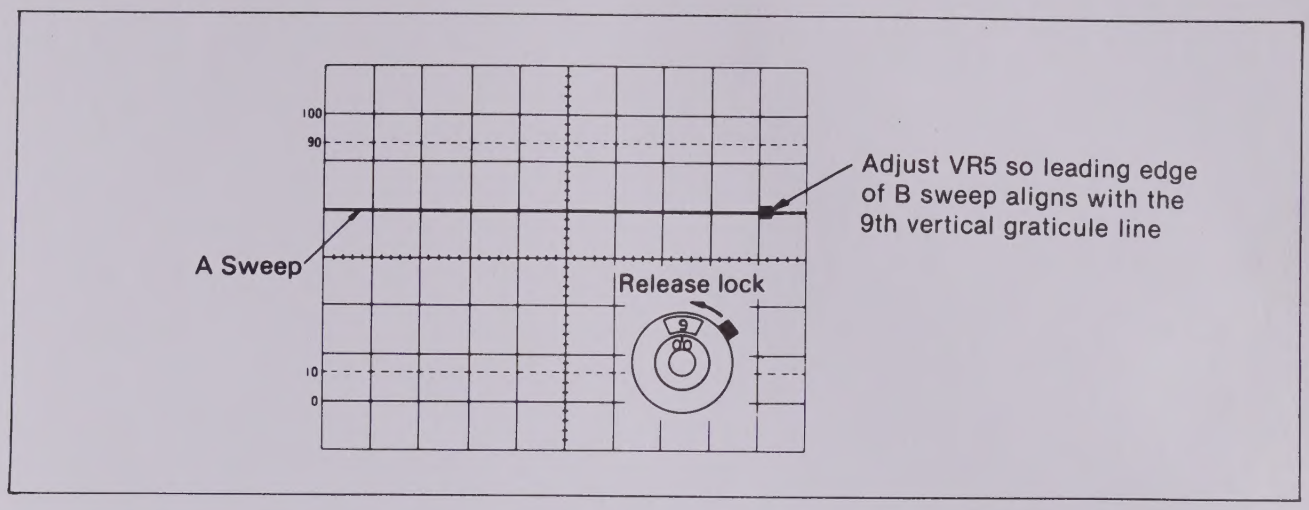
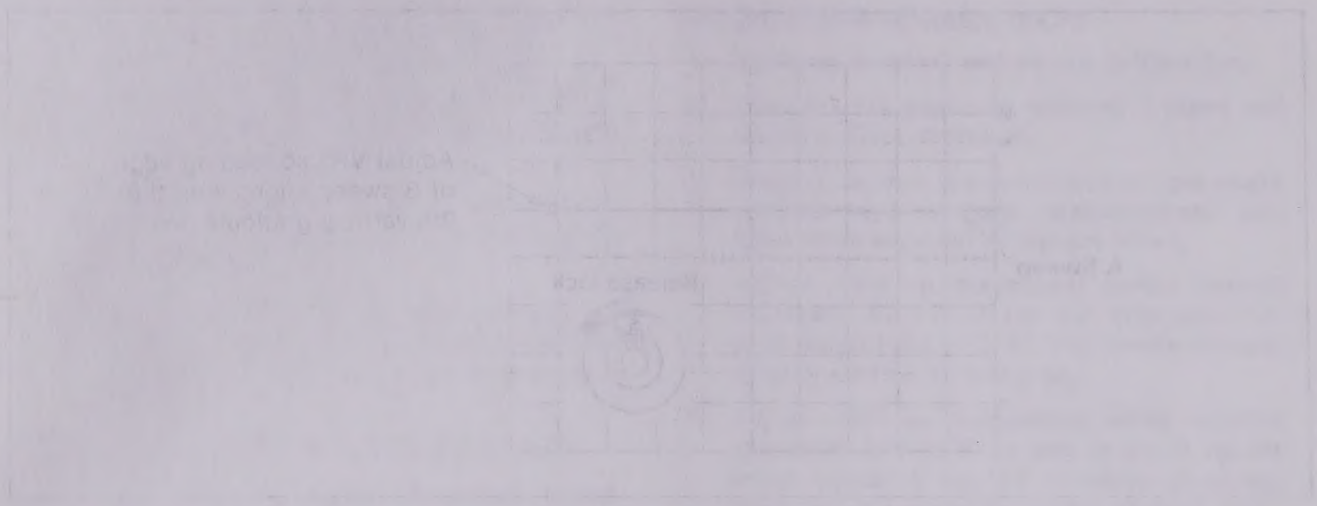
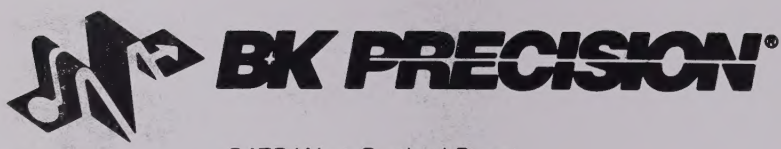


Fig. 63. Delay Check at 9.00.





6470 West Cortland Street
Chicago, Illinois 60635

© 1982 MAXTEC INTERNATIONAL CORPORATION Printed in U.S.A.

494-117-9-001